

JOINT TUBERCULOSIS

LEONARD W. ELY, M.D.



THE LIBRARY
OF
THE UNIVERSITY
OF CALIFORNIA
LOS ANGELES

GIFT OF

Mrs. H. F. Kamann

JOINT TUBERCULOSIS

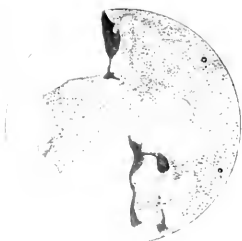


FIG. 1.

FIG. 1. Bone tuberculosis. Drawing of bony trabeculae undergoing rarefying osteitis. (Zeiss, objective V.) The section is taken from the side of a necrotic bone cavity. Observe the giant cells (osteoclasts) and the osteoblasts. The marrow is not drawn in the picture.

FIG. 2. Bone tuberculosis. Water-color drawing. Low power. Observe the tuberculous granulation tissue in the marrow bursting through the cartilage. No evidence is present of any "layers of fibrin" upon the cartilage, although the cartilage has been perforated sections of the synovial membrane failed to show any tuberculosis.

FIG. 3. Synovial tuberculosis. Low power picture showing marked hypertrophy of the synovium with extensive tuberculous involvement. At one spot may be seen a thickened artery. The superficial parts are necrotic. Granulation tissue is spreading under the cartilage,



FIG. 3.

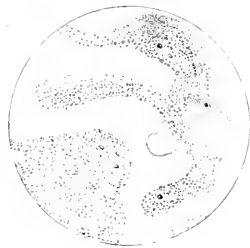


FIG. 5.

interfering with its nutrition, and at one spot starting to break through.

FIG. 4. Bone tuberculosis. Low power picture showing granulation tissue in the marrow and two areas of necrosis. The cartilage has been loosened by interference with its nutrition from beneath, but there is no evidence of any "layers of fibrin" on its surface. Water-color drawing.

FIG. 5. So-called bone tuberculosis. This water-color picture shows the typical tuberculous myelitis as seen under low power. Two areas of necrosis are present and several giant cells. The bone structure itself escapes.

(Illustrations reproduced by courtesy of the editor of *Surgery, Gynecology and Obstetrics*.)

JOINT TUBERCULOSIS

BY

LEONARD W. ELY, M. D.

CONSULTING ORTHOPEDIST TO THE COUNTY HOSPITAL; ATTENDING ORTHOPEDIST TO THE
CHILDREN'S HOSPITAL, DENVER, COL.; MEMBER OF THE AMERICAN ORTHOPEDIC
ASSOCIATION AND OF THE AMERICAN MEDICAL ASSOCIATION; ASSOCIATE
FELLOW OF THE N. Y. ACADEMY OF MEDICINE; FORMERLY SURGEON
TO THE SEA BREEZE HOSPITAL; CONSULTING ORTHOPEDIST
TO THE ROOSEVELT HOSPITAL; ORTHOPEDIC SURGEON
TO THE METROPOLITAN HOSPITAL, N. Y., ETC.

ILLUSTRATED

NEW YORK
WILLIAM WOOD AND COMPANY
MDCCCCXI

COPYRIGHT, 1911
BY WILLIAM WOOD AND COMPANY.

*Printed by
The Maple Press
York, Pa.*

THIS BOOK IS

DEDICATED TO MY FATHER.

"Seest thou a man diligent in his business? He
shall stand before kings."

686266

PREFACE.

It has been my ambition for some time to write a book on joint tuberculosis. Watson-Cheyne and Senn have both performed the task, but their books, practically the only ones in English, were written some years ago. The time seemed ripe for another work which should embody the more recent knowledge on this interesting branch of surgery.

This little book was started some two years ago, and was laid aside, because it seemed to consist of a collection of facts and opinions more or less disjointed, and without power to carry conviction; nor was there any authority to which I could go for filling in the gaps.

Joint tuberculosis has furnished the subject for a number of books and monographs in foreign languages, some of them most interesting and instructive, and for chapters in various works on surgery and on orthopædies, but most of these productions voice the results of their authors' experience exclusively, and they all manifest such a diversity of opinion, that one who would write a book on joint tuberculosis must needs follow the example of their authors and set down his own opinions, based on his individual clinical experience, or else must choose from among the conflicting opinions such as appeared most rational.

On this account I laid the work aside and betook myself to the pathological laboratory. Through the courtesy of Profs. Prudden and Wood, and later of Prof. MacCallum, of the College of Physicians and Surgeons, Columbia University, New York, the facilities of the college pathological laboratory were placed at my disposal. Dr. William C. Clarke kindly permitted me to make use of his excellent collection of joints and aided me in my earlier work. The material at our disposal, while fairly good, was not sufficient, and but for the kindness and interest shown by a number of New York surgeons, I should have been more or less hampered. I take this opportunity to thank these gentlemen for their generosity and aid, in contributing joints to our collection. These joints were carefully examined macroscopically and microscopically, and a large number of slides was made from them, somewhat more than 300.

The histories of the patients were abstracted, and the outcome of the cases was ascertained where this was possible. In this way we

were enabled, not only to study the joints, but also to find out the results obtained by different men with various methods of treatment. Many of the patients were my own, and any remarks that may seem invidious in the following pages will seem less so when I say that my errors were as egregious as those of any one else.

The astounding differences of opinion in all matters relating to joint tuberculosis make the comprehension of the subject extremely difficult; and after working for a few months I found that I could not fit my ideas into any of the accepted theories. Even many of the facts seemingly well established, such as the coagulation of fibrin in tuberculous joints, appeared impossible.

After about two years' work I again took up the book, and the enforced idleness incident to a change of residence has enabled me to push it to completion.

The bibliography of joint tuberculosis is very extensive, and it is manifestly impossible in a book of this kind to quote more than a few of the more important articles; enough for a proper understanding of the subject and enough also to enable anyone having a case which he wishes to look up to find here the authority that he needs. Would one go deeper, one has but to consult these references, and in them one will find other references that will soon enable him to trace any subdivision to any length.

It has not seemed wise to go deeply into the subject of braces, which is dealt with at length in orthopædic text-books, nor into operative technique, which is much better handled in works on general surgery.

If the views I advance seem radical, positive, and possibly somewhat over confident, be it remembered that they are based upon a fairly wide clinical experience, as well as upon laboratory work, and that in many instances the stained slides will be found to substantiate them.

It seems strange that, in a subject limited and narrow as this is, one cannot cover the ground oneself, from one's own experience; but it early appeared that a book written on such a plan would be more or less confined in its usefulness, and I have reached out and taken the best, wherever I could find it. It is obvious also that if I can base my conclusions partly on the observations of others they will have added weight.

I have been aided and encouraged by many: Dr. A. J. Markley's photomicrographs form a feature of the book. Dr. Eli Moschcowitz, of New York, has given me much valuable advice and assistance. Dr. J. W. Amessee has helped me in abstracting and in reading proofs. Drs. Freeman and Powers have placed their libraries at my disposal.

Dr. Webb in an excellent appendix has given a short account of the histology of the red marrow and of the life history of the tubercle bacillus. The editor of *Surgery, Gynecology and Obstetrics* has permitted me to use material which has appeared in his journal. Finally, I owe much to that brilliant group of men who have made Boston the centre of orthopædic surgery in this country.

DENVER, COLORADO,

April, 1911.

LEONARD W. ELY.

INTRODUCTION.

The treatment of joint tuberculosis at the present day is almost entirely empirical. The widest differences of opinion exist as to the interpretation of the phenomena of the disease, and few facts have been established beyond peradventure. As in other cases, so in this, the diversity in the last analysis depends upon ignorance. We are ignorant of many of the fundamental facts that would enable us to reason to a logical conclusion, and we have tried to substitute clinical experience for exact knowledge—to reason back, so to speak, from effects to causes, and to regard what we believe as what we know.

The study of the pathology of bone and joint tuberculosis seems to have been comparatively neglected. With a few notable exceptions, those who have written on the disease have confined their attention to its clinical side, and most writers who have studied the pathology have been content with examination of the gross specimen. Now, no disease can be understood unless its pathology is known, and we cannot know the pathology without the aid of the microscope. The individual may not interpret correctly what he sees, but if he set down what he has seen, even if it conflict with authority, his observations cannot but be of value to those following the same paths. Good authority is not lightly to be set aside, but we often find on closer observation that what we have taken on good authority as facts turn out to be merely surmises.

Much of what follows has not been absolutely proved, and some of it may be overturned by those who come after, but I am convinced that in the study of the pathology, corrected by clinical experience, I have found the key to the phenomena of joint tuberculosis, or at least have laid hold on the thread that will eventually help to unravel the tangle.

SECTION I.

JOINT TUBERCULOSIS IN GENERAL.

JOINT TUBERCULOSIS.

CHAPTER I.

ÆTIOLOGY.

Definition.—Let us in the first place lay down a definition of the term “joint tuberculosis.” It is the reaction of the tissues in and about a joint, or of some of them, to the presence of tubercle bacilli and of their toxins. These can reach the joint only through the blood,¹ except in rare instances of direct infection from without the joint.² Müller³ produced the disease in animals by the injection of pure cultures of the tubercle bacillus into the nutrient arteries of bones.

Many investigators have injected the joints of animals with pure cultures of the tubercle bacillus. Pawlowsky injected the larger joints with a pure culture of tubercle bacilli. He found that the first to be affected were the “conjunctival” cells of the synovia, and the lymphatic lacunæ. The phagocytes succumb in part in the fight against the bacilli. Others engulf the bacilli and carry them far away from the focus.⁴

Parenthetically, it may be said that those who have injected the joint itself with tubercle bacilli have produced a tuberculous abscess in the joint, and thus have not exactly imitated nature’s method. Conclusions drawn from a pathological examination of these tuberculous joint abscesses are therefore of little value to us in our study of true joint tuberculosis. Whether, in patients suffering with the disease, the bacilli are carried to the joint primarily, or whether they are brought from some other focus in the body, has not been definitely determined. König, in a series of autopsies, was unable to find in

¹Possibly infection may exceptionally be through the lymph channels. See Friedrich, *Deutsche Zeit., f. Chir.*, 1899, Bd. 53, S. 514.

²Kappis. *Beitrag zur traumatischen Tuberkulose*, *Deutsche med. Wochenschrift*, 1910, No. 28. The author gives the history of a severe case of bone and joint tuberculosis following a compound fracture of the femur, resulting in death.

³Müller. *Experimentelle Erzeugung typischer Knochentuberkulose*, *Centralbl. f. Chir.*, 1886, No. 14, S. 233.

⁴See also Hueter, *Die experimentelle Erzeugung der Synovitis granulosa*, etc. *Deutsche Zeit. f. Chir.*, 1878–9, xi, 317–330.

20 per cent. any tuberculous lesion other than that in the joint.¹ Others maintain that joint tuberculosis is always secondary.² When the bacilli are deposited in the neighbourhood of a joint, they give rise to the formation of the typical tubercle, and almost at this point we may take leave of theory and may trace the succeeding steps of the disease.

The primary cause of joint tuberculosis in every instance is the tubercle bacillus.³ Under the head of contributing causes come heredity, environment, injury, and acute infectious disease.

Heredity.

The influence of heredity has been the subject of much discussion. That there is a type of patient in whom the affection is most frequent is probably true, but, on the other hand, the opinion that the disease itself can be inherited has been abandoned. One inherits the liability to the disease, or rather the inability to resist it.

Statistics on this point are notoriously unreliable. In dispensary practice the difficulty of obtaining correct data is especially notable. The more carefully the enquiry concerning tuberculous relatives is pursued, the more frequent will be the positive answer. To a point-blank question whether any tuberculosis exists in the family the answer, in the vast majority of instances, will be a negative one. Further endeavour will often elicit a different answer.

Environment.

An unhealthful dwelling place will lower the vitality and thus decrease the resistance to the disease. The same may be said of unhealthful occupation, insufficient food, etc., but an infected dwelling has a much more important bearing upon the incidence of the disease. This fact has an important bearing on the question of heredity. Doubtless many of the cases that have been ascribed to heredity were far better considered as due to the infection spread about by a tuberculous relative.

It is impossible to assign to each of the various factors its proper value. Tuberculous joint disease is more frequent among the poorer

¹ König. *Die Geschichte der Entwicklung der Gelenktuberkulose*, Deutsche Klinik, Berlin and Wien, 1905, viii, 67-74.

² Vide Adami and Nichols. *Principles of Pathology*.

³ "Many authors, among them Durante (Italian Surgical Society, 1887), affirm that a great number of joint affections besides rheumatism are fungous without being tuberculous. In truth, it is possible that some fungous arthritides can be simple chronic lesions, but clinically this is a rare phenomenon. According to Koch, the tubercle bacillus exists in only two out of four fungous arthritides; according to Cornil and Babès only in one out of three. Is it necessary to conclude, then, that only a third or a half of these whiteswellings are tuberculous? Not at all. It is only necessary to recognise that the tubercle bacillus does not comprise in itself alone all the infectious characteristics." (Lagrange. *Traité de Chirurgie*, 1901.)

classes than among the well-to-do. This has been regarded as due to lowered vitality, but it is more probably due to greater exposure to infection. Sick and well are crowded together in such a way that proper isolation is almost impossible. To this fact must be added the ignorance and carelessness of the very poor in sanitary matters.

Most of the cases of joint tuberculosis are found in the cities. In the larger cities (I speak especially of New York) the shifting of the population is constant and wide-spread. Until recently no attempt at disinfection of infected dwellings has been made, and even at present the disinfection is not absolutely reliable. It is seen, therefore, that contagion can easily occur without discoverable cause. The entire trend of modern opinion is away from heredity and toward infection from without.

Injury.

Before the real nature of tuberculous joint disease was discovered, it was regarded as due usually to an injury. Since then the influence of this factor has been much debated. The experiments of Krause¹ demonstrated that an injury to the joint of an animal that had been inoculated with tuberculosis, often was followed by tuberculosis of that joint, and in actual practice the sequence of the disease upon a distinct trauma is occasionally unmistakable, but in the great majority of cases no such sequence can be traced. Indeed in children, in whom, as we shall see, a bony focus is the rule, the portion of the bone in which the focus usually occurs is in no way exposed to injury. It is no more necessary to predicate an injury in joint tuberculosis than in pulmonary or lymph-node tuberculosis. In the synovial type, on the other hand, the influence of trauma is more easily understood.

Trauma must not be assumed because the ordinary function of a joint exposes it to trauma. The structure of a joint is, of course, adapted to withstand the ordinary strain to which it is exposed, and an injury so slight as to cause no symptoms may be disregarded as a factor in the production of the disease.

The tendency of the patient or of his elders to ascribe his ailment to injury must always be borne in mind, and must be discounted. If any considerable interval elapse after the injury, the causal relation is very doubtful. Again, close questioning will often bring out a history of previous joint symptoms that have merely been aggravated by the trauma. Fractures and dislocations are never followed by joint tuberculosis; the injury is usually a wrench or a strain.

¹ Krause. *Tuberkulose der Knochen und Gelenke*, Leipzig, F. C. Vogel, 1891.

Krause's experiments have been very widely quoted, and have received more or less general acceptance, but other experimenters have arrived at conclusions diametrically opposite. Friedrich,¹ for instance, performed experiments similar to those of Krause, and could find no causal relation of trauma to joint tuberculosis. According to him, uninjured joints were just as liable to the disease as the injured ones.

Sprengel has called attention to the fact that those joints which are most exposed to injury are relatively infrequently affected by tuberculosis; *e.g.*, the hand. Cornet affirms that too much weight has been laid on trauma as a cause of joint tuberculosis.²

Tillmanns says: "Traumatic injuries of the bones favour . . . the occurrence of tuberculosis."³

Roswell Park says: "In many instances these follow the slight circulatory disturbances brought about by contusions, sprains, etc."⁴

"If symptoms of tuberculosis develop after an injury, it is probable that an encapsulated focus, which up to the time the injury was received had produced no symptoms, has been ruptured. The disease usually follows the lodgment of infected emboli, and the tubercle bacilli are not deposited from the blood stream at the *locus minoris resistentiæ* as is the case with pyogenic cocci. The results of the experiments of Friedrich and Honsell show that the deposition of tubercle bacilli is not determined by trauma, but of course an embolus infected with tubercle bacilli may accidentally lodge in a bone at the seat of injury." (Lexer-Bevan. General Surgery.)

The truth is to be found somewhere between the two extremes. Trauma is not essential to the occurrence of the disease, and probably does not cause a very large percentage of the cases, but, inasmuch as the infective material is supposed to be floating in the blood, any small injury to the joint that causes a minute hæmorrhage may possibly determine the location of the disease at that point.

As to the reason why greater injuries, such as fractures and dislocations, do not give rise to joint tuberculosis, we are driven back to a rather lame explanation. It is said that the vigorous processes of repair suffice to carry away the inflammatory exudate. Perhaps the quaint observation of Buchan may have some truth in it. In discussing "Strains" he says:

¹ Friedrich. Experimentelle Beiträge zur Kenntniss der Chirurgischen Tuberkulose, Deutsch^e Zeitschr. f. Chir., 1899, Bd. 53, No. xvi.

² "Auf das Trauma scheint oft ein zu grosses Gewicht gelegt zu werden. Mit recht macht Sprengel aufmerksam, dass die Skeletabschnitte die den meisten Traumen ausgesetzt sind, z. B. die Handgelenksgegend, relativ selten an Tuberculose erkranken." Cornet. Specielle Pathologie und Therapie, Bd. 14, iii., Theil.

³ Tillmanns. Lehrbuch der allgemeinen Chirurgie, 1901.

⁴ Park. Modern Surgery, Lea Bros. and Co., 1907.

“Strains are often attended with worse consequences than broken bones. The reason is obvious; they are generally neglected. When a bone is broken the patient is obliged to keep the member easy because he cannot make use of it; but when a joint is only strained, the person, finding he can still make a shift to move it, is sorry to lose his time for so trifling an ailment. In this way he deceives himself and converts into an incurable malady what might have been removed by only keeping the part easy for a few days.” (Buchan's Domestic Medicine, London, Milner and Sowerby, 1782.)

It is not probable that an ordinary joint inflammation can change into a tuberculous one, but that it cannot so change has not been proved.¹

Acute infectious disease is recognised as a distinct predisposing cause, especially in childhood. Measles ranks first, then whooping cough, and then scarlet fever and pneumonia.

Occurrence.

Joint tuberculosis occurs at all ages, and in both sexes, but it is essentially a disease of childhood. It is exceedingly rare in children under one year of age. The male sex furnishes a small majority of the cases. The reason that so few cases occur in the first year of life is probably that there is then very little bone in the region of the joints. The portions of the joint which later in life are composed of bone are then composed of cartilage, whose resistance to tuberculosis is well known.

The reason that the male sex furnishes more patients than the female is that it uses its joints more, and therefore has more functional elements in them. What bearing this has we shall see later on.

As to the frequency of occurrence of the disease in the various joints, it may be said roughly to be proportionate to their size. The sacro-iliac joint furnishes a marked exception to this; this joint is rarely affected.

Nélaton gave this order of frequency: knee, hip, tibio-tarsal, elbow, shoulder, wrist, and tarsus. Jaffe gave these figures: spine, 26 per cent.; foot, 21 per cent.; hip, 13 per cent.; knee, 10 per cent.; hand, 9 per cent.; elbow, 4 per cent. According to Whitman the order of frequency is somewhat as follows: spine, hip, knee, ankle and tarsus, elbow, wrist, and shoulder.

Sprengel gives this frequency. Spine, hip, the small bones of the hand and of the foot, the knee, the elbow, the shoulder, and the wrist.

¹ “Tres souvent par conséquent les accidents articulaires ne sont rhumatismaux qu'en apparence, et l'élément spécifique exist des les premiers jours.” Lagrange. Traité de Chirurgie.

CHAPTER II.

PATHOLOGY.

Tissues Involved.

Of the four essential structures of a joint, bone, cartilage, ligament, and synovial membrane—all connective-tissue structures, and all formed from the mesoblast—the first and the last offer the field for primary invasion.¹ This view has been held for many years abroad, but in America, largely owing to the teachings of Nichols of Boston, the opinion has prevailed in recent years that all cases of joint tuberculosis originate in a bony focus.² Nichols,³ basing his conclusions upon a study of more than 120 specimens, wrote that even those cases which seemed to be primarily synovial, if examined carefully, would show that the synovial disease was merely an extension from that of the bone.

This theory is attractive and simple, but our observation does not confirm it. In the first place, primary synovial tuberculosis is found in tendon sheaths, which differ in no essential from the synovia of joints. In the second place, a careful study of our specimens fails to reveal in a number of them any bony involvement whatever, and in many of them any signs of a bony focus. Third, there seems to be a difference, more or less plainly marked, in the clinical behaviour of synovial cases and of those of bony origin. Again, in many cases in which the bone and synovial membrane are both involved, the damage to the bone is so insignificant and that to the synovia so extensive, that it seems impossible for the disease to have started in the former and to have spread to the latter with so little damage to its original host.

We quote three cases for illustration: A woman patient with extensive pulmonary tuberculosis underwent in Roosevelt Hospital an excision of her tuberculous right ankle. Shortly after, her leg was amputated on account of a secondary infection. No mention was made in her history of any disease of the other leg. She was discharged cured from the hospital, and returned in six weeks with a

¹ Adami maintains that joint tuberculosis may begin in the periosteum. Other writers also ascribe to the periosteum an important role in the disease. Possibly the innermost layer may be vulnerable to an unmixt tuberculous infection, but I believe that the periosteum plays the same part as do other fibrous tissues—a passive one.

² The term "bone tuberculosis" is confusing. The disease were better called "tuberculous myelitis." Myelitis as applied to the spinal cord is a misnomer.

³ Journal of the American Orthopaedic Association, 1898.

typical tuberculosis of her left knee. This was resected and showed in the laboratory very extensive disease of the synovia, but no bone involvement. For the process to have originated in bone after her discharge, and then to have spread throughout the synovia, is improbable. That a bony focus in her left knee could have existed

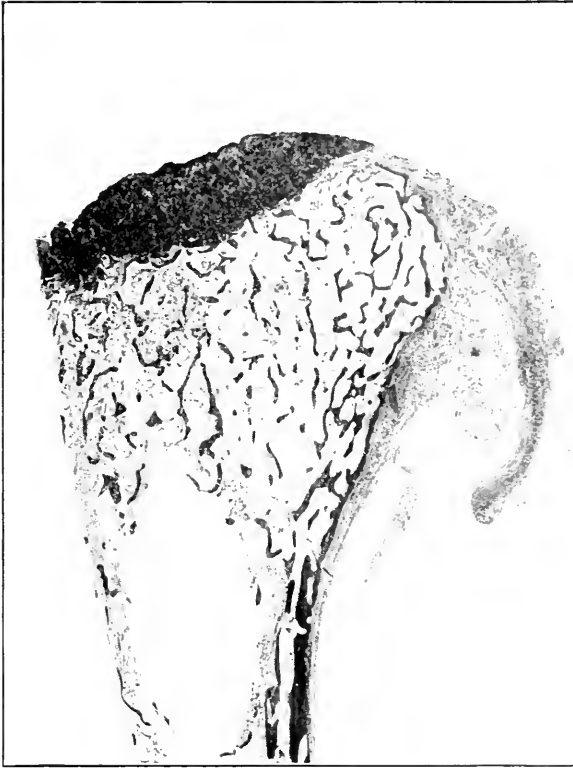


FIG. 1.—Tuberculosis of the metacarpophalangeal joint. Synovia and bone both are involved. Section from phalanx; $\times 10$ diameters.

during her first stay, and could have escaped attention seems even less likely to one acquainted with the symptoms attendant on bone disease.

Another patient, under the writer's conservative treatment for five years, consented finally to a resection of his knee. The bones showed no tuberculosis, but the synovial membrane was involved.

Another patient gave a history of seven years' duration of his symptoms, and had very slight evidences of pain or of disability.

He had a moderate amount of fluid in his joint, and slight limitation of motion, but no circumarticular thickening, and little if any muscular atrophy. An exploratory incision was made into the joint, and several tabs, hanging from the synovia, were snipped off. The cartilages appeared perfectly smooth, and, as the gross appearance of the joint did not surely indicate tuberculosis, the operator sewed up the wound. A laboratory examination of the excised material revealed typical tuberculosis. An excision done two months later showed that the

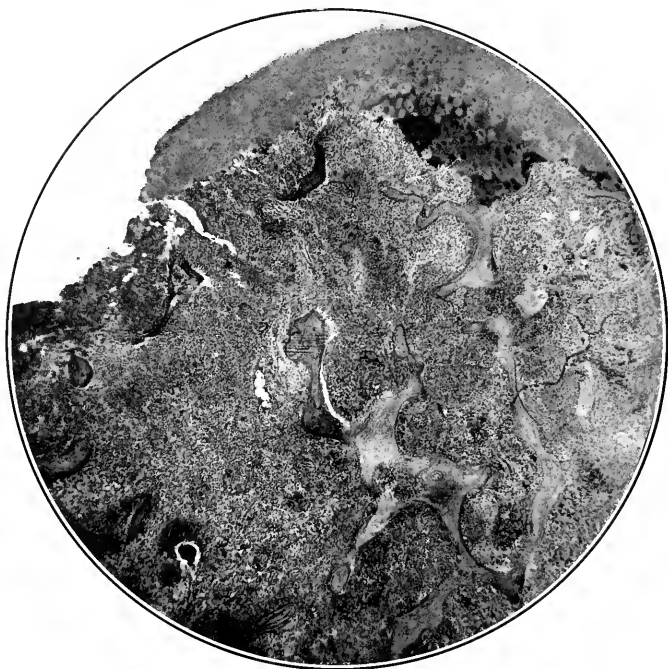


FIG. 2.—Tuberculosis of bone marrow at margin of the articular cartilage.

cartilages, smooth before, had become eroded, but no tuberculosis could be found in the bone. Collections of cheesy material were scattered throughout the synovia.

Other cases could be quoted, but these will suffice for our purpose.

To prove absolutely in any case that a minute bony focus might not be present would be an exceedingly difficult matter, but, given the occurrence of primary synovial disease in tendon sheaths, the failure to find a bony focus by a careful examination of a number of joints in which the synovia is extensively diseased, may be accepted as conclusive.

In many of our specimens the disease has spread so far that its origin could not be determined. In others it could be told with reasonable certainty. We think that primary bony and primary synovial involvement occur with about equal frequency in adults, from whom most of our specimens were taken. In children primary synovial disease is thought to be rare. Tuberculosis starts in the marrow or in the synovia, and, as we shall see, while the disease is uncomplicated in the joint, it remains in them.

Rovsing¹ has called attention to a form of joint tuberculosis occurring in very young children. He reported six cases in children under one year of age, all coming on acutely, and all healing promptly with good function after a simple arthrotomy. In his opinion most of the cases of acute arthritis in young children are tuberculous and are purely synovial, not involving the bone if properly treated.

Cases Starting from a Bone Focus.

We shall discuss first the pathology of the cases beginning in a so-called bone focus, and, inasmuch as in the knee the disease can best be observed, it is the custom of writers on joint tuberculosis to take this joint as typical. We shall follow this custom the more readily because most of our specimens are from the knee.²

The primary tubercle is formed in the marrow of the epiphysis of one of the long bones, or in that of the patella, and, as in other organs of the body, the tuberculosis spreads at the periphery. Other tubercles form and coalesce, and have a tendency to break down at the centre and to become necrotic.

The granulation tissue thrown out around the tubercles in the effort of repair may also become invaded, or it may become converted into fibrous tissue and form a capsule more or less complete. In some of our specimens the division of the tuberculous tissue by fibrous septa is well marked.

The amount of fibrous tissue often affords an approximate idea of the clinical course of the disease. Slow, chronic, dry cases are apt to show a profuse production of fibrous tissue, whereas those of more rapid course, characterised by the breaking down of tissue and by the

¹ Th. Rovsing. Ueber tuberculose Arthritis u. Ostitis im fruhesten Kindesalter, Archiv. f. klin. Chir., liii, 620.

² These are seventy-two in number, removed from sixty-four patients. From four of these patients two specimens were removed from the same joint at different times; from three others the second specimen was removed from another joint. They are divided as follows: Of the knee, thirty; of the ankle and tarsus, ten; of the hip, nine; of the elbow, seven; of the wrist, seven; of the shoulder, three; of the sterno-clavicular joint, one; and of the fingers and toes, one each. Besides these we have a specimen from the humerus and one from the tibia, in which no joint was involved. Forty-one male patients contributed forty-six specimens; seventeen female, nineteen joints. In seven cases the sex was not mentioned. In addition to our clinical material we have injected eight joints in three dogs with a pure culture of the tubercle bacillus.

formation of abscesses, show very little. In these latter, new, poorly organised granulation tissue predominates.

“In the beginning the focus is grayish red in colour, and translucent, but becomes yellowish as caseation occurs.” (Lexer-Bevan. General Surgery.)

A study of these specimens teaches the impracticability of the attempt to divide the disease into stages or periods of active invasion



FIG. 3.—Tuberculosis of the elbow; synovial type, showing the tuberculous process making its way through the periosteum into the bone under the margin of the articular cartilage. Section through the coronoid process; \times about 20 diameters.

and repair. The process does not advance to a certain point and then recover, but almost invariably invasion and repair exist together, sometimes at the same part of a joint, sometimes in different parts, and according to the preponderance of one process or of the other, the disease tends to recovery or to extension. The tuberculous granulations advance in the marrow, and, surrounding the trabeculae, shut

off their nutrition and kill them, either *en masse*, with the formation of a sequestrum, or in small particles, giving us the "bone sand" so characteristic of the disease. Often the trabeculae have undergone rarefying osteitis, often a productive osteitis. The behaviour of the trabeculae strongly suggests an analogy to that of the soft tissues—at first a tendency to the production of new tissue to wall off the disease, and then invasion and breaking down. Sometimes the trabeculae may be seen lying dead, surrounded by pus cells.

The attempt to describe the various shapes of the tuberculous areas, and to classify the cases on this basis seems futile. One ex-

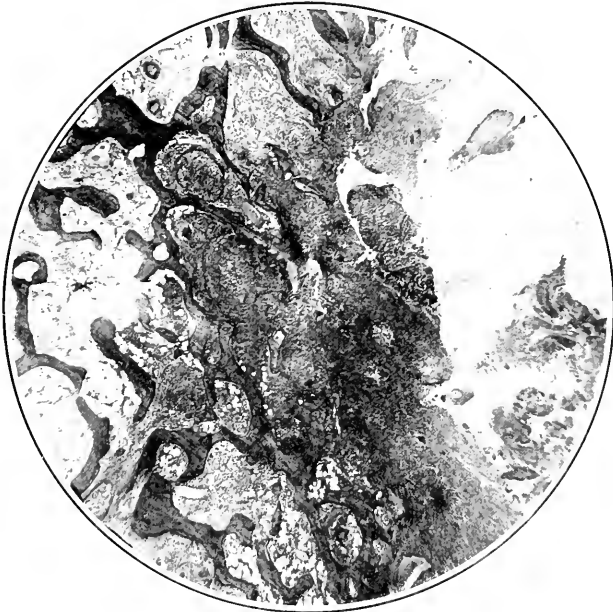


FIG. 4. Portion of wall of tuberculous bone cavity.

ception may be made to this. Many cases, described by numerous authors, are characterised by the presence of conical or wedge-shaped foci with their base toward the joint. These are supposed to be caused by the lodgment of a tuberculous embolus in one of the end-arteries of the epiphysis of developing bone. According to Lexer a rich anastomosis is found among these vessels only after the epiphyseal cartilage has become ossified.

The use of the terms "caries sicca," "joint fungus," etc., seems also unwise, as indicating distinct morbid processes, whereas they are merely different forms of the same disease. "Caries sicca" is the

form usually found in elderly people, characterised by a slow, dry course, without the formation of abscess. The head of the bone is eroded, and often eaten almost entirely away. In joint fungus, on the other hand, there is a marked proliferation of soft, poorly organised tuberculous granulations of the soft parts in and about the joint.

The bone in the vicinity of the disease may be soft and may cut

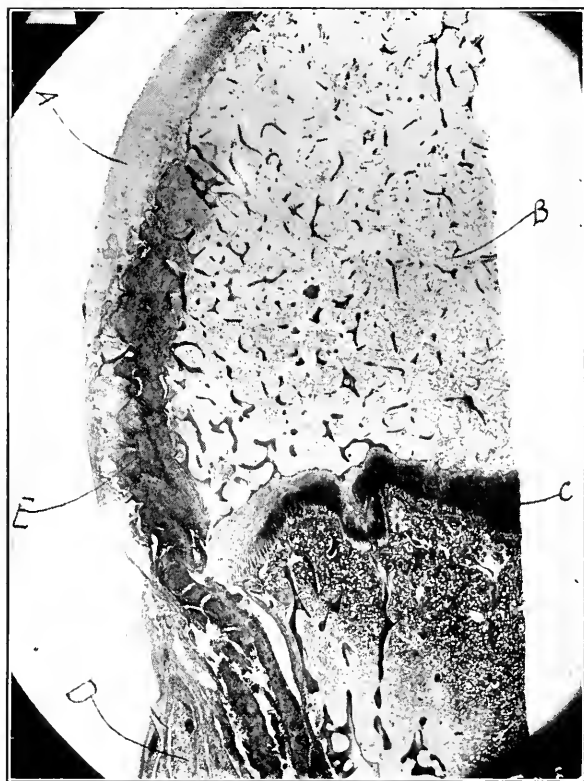


FIG. 5 — Bone tuberculosis, showing the spread of the tuberculous process under the periosteum and cartilage; specimen from the external condyle in a 12-year-old child. The joint is not yet involved; $\times 8$ diameters. A, Articular cartilage; B, epiphysis; C, epiphyseal line; D, periosteum; E, area of tuberculosis.

easily with a knife, or it may be much harder than normal. Often at operation drops of fat will cling to the saw, the so-called "fatty osteomalacia." Sometimes when the bone is cut for sections it will float in water.

The tuberculous granulations, spreading in the marrow, may find their way directly to the periosteum, and, breaking through this,

may form an abscess in the surrounding tissues, and so reach the surface without ever involving the joint, but as a rule the layer of dense bone at the circumference and the periosteum are impregnable, and the disease must spread upward toward the shaft or downward toward the joint. The marrow of the spongy bone in the direction of the joint affords the best field for its growth. The cartilage offers a barrier to its progress, and when the tuberculous granulations reach it, one of three things happens: viz., 1, They deprive of its nutrition the

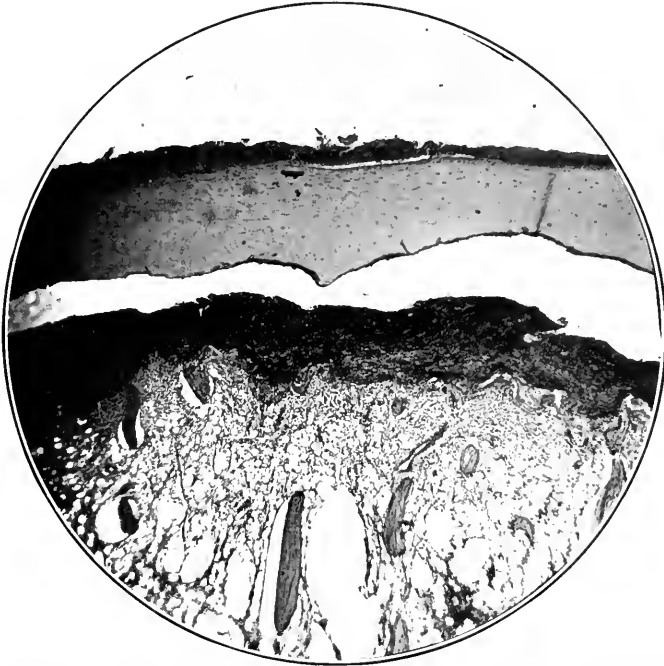


FIG. 6.—Lifting off of cartilage. Disease of subjacent bone marrow. The cartilage near the joint surface has undergone fibrillation. This is probably what has been mistaken for fibrin.

portion of the cartilage under which they lie, and perforate it; 2, The granulations spread out underneath the cartilage, and, shutting off the nutrition of a large area of it, lift it off in a leaf or flake, and thus reach the joint; or 3, they may burrow beneath the cartilage and gain access to the joint at the side.

During this process the joint may be the seat of a serous effusion. When it is once involved, the disease may spread rapidly through all its structures, involving the synovial membrane and the other bones, or it may involve only parts of the joint, and leave the rest almost normal. Where the bones are covered by cartilage they are

protected against invasion from the joint side. The disease must make its way into them at the margins of the cartilage.

Frequently adhesions are formed in an apparent attempt to shut off the disease, similar to those in the peritoneal cavity or in the pleura; and sometimes sections from one region will show normal joint structure, while from another they show typical tuberculosis: Hence the unreliability of a single section removed from a joint for diagnosis.

"I have often, for the sake of illustration to medical students

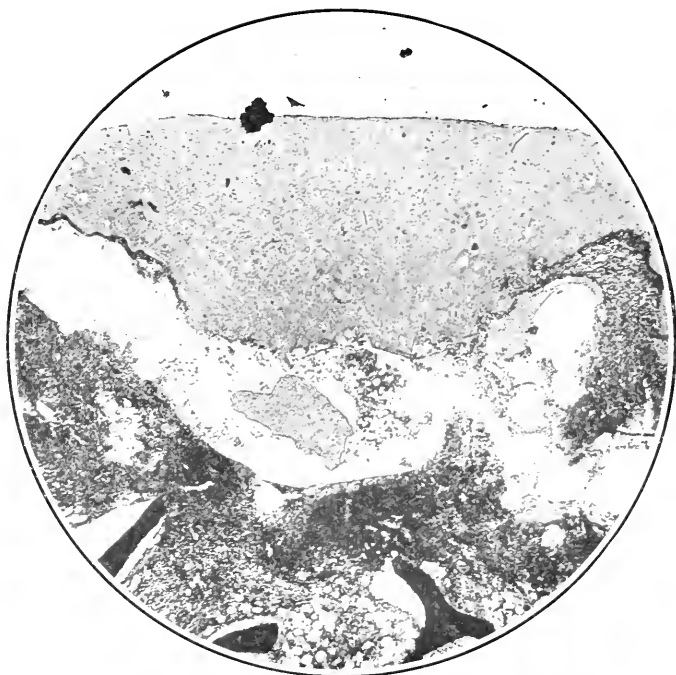


FIG. 7.—Destruction and lifting off of joint cartilage. No "layers of fibrin" can be demonstrated.

drawn a certain analogy (following Savory) of the gross resemblance between lungs and bones in their behaviour when involved in tuberculous disease. In either case the structure is in a measure spongy and contains cavities and networks of tissue; in each case the structures are invested by a resisting membrane—in the one instance pleura, in the other periosteum. Again, each is closely related to a serous cavity, the lungs to the pleural cavity, the bones to the serous cavities of the joints. Perforation into the adjoining serous cavity is frequent, and previous to perforation collections of serous fluid are frequently noted—in the one instance pleurisy, in the other hydrarthrosis.

Moreover, these fluids may frequently become contaminated, and then become purulent, constituting empyema or pyarthrosis as the condition may be. One sees, too, in each place the same striking combinations of weakening of tissue and strengthening in order to atone for the undermining of the disease." (Park, *Modern Surgery*, 1907.)

Often one condyle and the opposite tuberosity will be badly involved, while the other condyle and tuberosity are practically sound.

The further course of the disease now will depend on the relative production of fibrous tissue and of soft granulation tissue and of



FIG. 8.—Entire thickness of tuberculous synovia—40 mm. objective.

serum. If the fibrous tissue predominate, the tuberculous granulations are slowly encapsulated as they form, and the joint becomes in whole or in part a mass of fibrous adhesions which deprive it almost entirely of motion. If the soft granulations be not organised, white corpuscles and serum are added to the liquefying mass, and a cold abscess is formed which, breaking through the capsule, escapes into the surrounding tissues, and then, becoming secondarily infected with pus germs, gains the surface and discharges its contents.

Clinical experience teaches that in children the process may be halted at almost any stage, and the joint may recover with a fair range of motion. In some cases complete bony ankylosis takes place,

especially after a mixed infection. In adults, we believe that neither of these results is ever obtained, and that cure is always brought about by fibrous encapsulation, and is seldom if ever complete.

"The tuberculous products may be encysted or they may degenerate or may be absorbed. Here, as in the lung, cicatrization is possible without treatment." (Lagrange.)

"A tuberculous focus in bone may heal spontaneously. The bacilli are then overcome by the resistance of the tissues, and the focus is either encapsulated or replaced by newly formed connective tissue. As would be expected, spontaneous healing occurs most frequently in small circumscribed foci in which there is no sequestrum formation. Virulent bacilli may remain in the encapsulated or healed foci, from which recurrences develop, when the capsule is destroyed or the resistance of the tissues lowered by trauma. The spontaneous healing of tuberculosis of the spine demonstrates that even the larger sequestra may become encapsulated." (Lexer-Bevan. General Surgery.)

Cases with a Synovial Origin.

In the cases with a synovial origin, the primary tubercle is formed in the membrane itself, not, as König teaches, by the infection of the surface layers from a "tuberculous exudate" in the joint cavity. The synovia may be badly diseased and still have a smooth, healthy-looking surface.

In our opinion the disease usually begins in the folds or fringes found in the recesses of the joint. The disease may remain more or less localised, or it may spread throughout the entire joint, with or without involvement of the bone. The fringes and villi become thickened and enlarged, and the entire membrane may also be much thicker than normal.

One of our cases was characterised by the formation of pedunculated bodies hanging in the joint (*lipoma arborescens*), varying in size from that of a pea to that of a large lima bean, and on section of one of these bodies a spot of calcification was revealed.¹

Tubercles may often be seen by the naked eye studding the synovia, and scattered through its substance. The folds of the membrane may be so hypertrophied as almost to hide the articular cartilage. They seem to be adherent, but usually are found to be merely lying upon it.

Microscopically the typical tubercles are seen, often with areas

¹ For an excellent article on pedunculated tuberculous tumours in the knee-joint, see Reynier, *Revue de Chirurgie*, xxxii, 1905, p. 394.

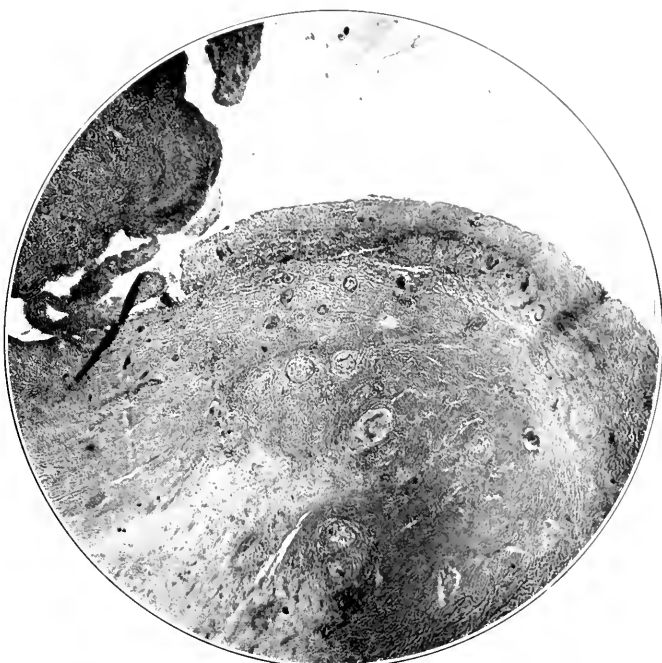


FIG. 9.—Tuberculous synovia, showing well-marked effort at encapsulation of the tubercles—discrete tubercles.

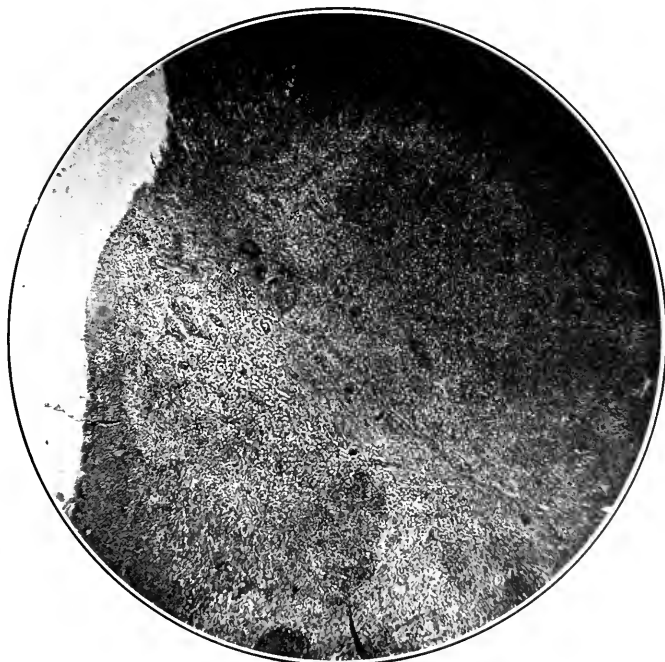


FIG. 10.—Synovial tuberculosis, with little tendency to encapsulation.

of necrosis. In joints that have been long diseased the synovia may have almost disappeared, *leaving little else than fibrous tissue.*

Sometimes the production of fibrous tissue is well marked in the diseased area, sometimes one finds abundant new granulation tissue in the membrane or upon it. The layers of fibrin emphasised by König are not often present.

The frequency of obliterating endarteritis in tuberculous joints has not been appreciated. It was present in the majority of our specimens to a marked degree.

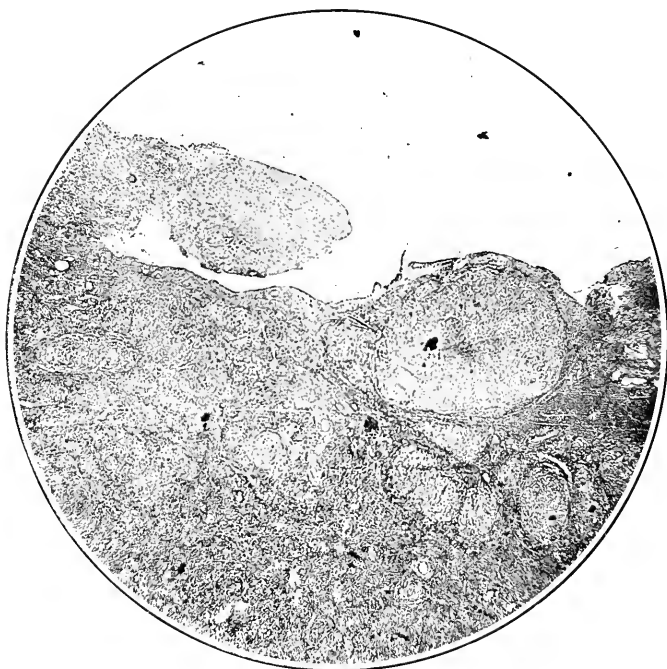


FIG. 11.—Tuberculous synovia.

Rice Bodies.

In one or two of our joints we have seen the “rice bodies,” which have been described by others. These are small, smooth, hard bodies, like melon seeds, often occurring loose within the joint.¹ In one

¹ “The so-called rice bodies, which may fill the greater part of the joint, are round and compressed, resembling seed-corn in shape. They are soft and white and are covered with an exceedingly slippery exudate.

“Often similar structures are attached to the synovial membrane by a pedicle; frequently they are free in the joint, but a connective-tissue center indicates that the pedicle has been destroyed and that the bodies which are free in the joint were formerly attached. These bodies should always be regarded as the product of tuberculous inflammation, for they, like the exudate, contain tubercle bacilli.” (Lexer.)

case we found a collection of them surrounded by a well defined capsule, like a pomegranate with its seeds inside. This would dispose of the theory that they are always formed by the precipitation of the contents of the joint. Unless they can be formed in more than one way, their method of formation is probably in a capsule from which they are later set free.

Riese agrees with König, Landow, and others that rice bodies are the result of a coagulation of fibrin.¹



FIG. 12.—Rice bodies in their capsule. 40 mm. objective.

According to Schuchardt, Garré, and Goldmann, rice bodies are to be regarded as degenerative products of diseased synovial membranes.

Goldmann² maintains that these rice bodies are due to the changes in the synovial membrane proper. He holds that they are usually the result of tuberculosis, but may occur independently of it, and that they are the product of cell degeneration and not of the deposition of

¹ "So muss ich mich vollkommen der Ansicht König's, Landow's, und ihrer Vorläufer anschliessen, dass sämtliche Reiskörperchen in tuberculösen Gelenken, Schnenscheiden und Schleimbeuteln in letzter Linie Derivate einer Fibringerinnung sind. Die eine Hauptgruppe derselben entsteht aus Gerinnsen, die sich in der Synovial flüssigkeit selbst bilden, die andere Hauptgruppe aber geht aus Niederschlägen hervor, die auf der Wand der Synovialhöhle abgelagert und von den Zellen derselben zum Teil organisirt worden sind." Riese; Die Reiskörperchen in tuberculös erkrankten Synovialsäcken. Deutsche Zeitschrift für Chirurgie, xlix, 1.

² Goldmann. Beiträge z. klin. Chir., Bd. xv, Heft 3, S. 757.



FIG. 13.—Rice body. Zeiss objective aa, ocular 3.

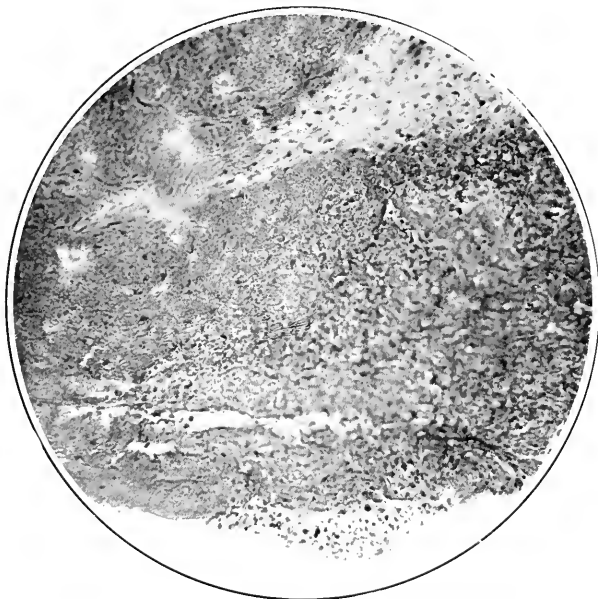


FIG. 14.—Section through rice body. Zeiss objective C.

fibrin. He says that tuberculous joints in which they are found run a slow course and are very amenable to treatment.

I am inclined to view these rice bodies as the evidence of a rather effective effort at cure, as an exaggeration of the usual process of walling off the disease by fibrous tissue.

In those cases in which the synovia is affected secondarily from a bone focus, the changes may be much the same as in the primary, form, except that possibly the rice bodies and pedunculated bodies are peculiar to the latter.

"In the caseating form of tuberculous arthritis the synovial membrane is covered with and partly transformed into soft, spongy granulation tissue, while the para-articular tissues are œdematous." (Lexer-Bevan. General Surgery, 1908.)

It is necessary for a thorough examination of these joints that sections be made from many parts of them; otherwise one's conclusions are liable to error. In one of our specimens, diagnosed before operation as tuberculous arthritis of the ankle, a laboratory diagnosis had been made of "chronic inflammation; no tuberculosis." Not satisfied with this diagnosis we submitted the joint to a very careful second examination, and at length found in a recess in the midst of the fibrous adhesions with which the joint was filled, a small cheesy nodule about 25 mm. in diameter, which under the microscope proved to be an old encapsulated tubercle.

The Ligaments.

We have seen that while the bone is being destroyed by the growth of the tuberculous tissue in its meshes, that is, in the marrow, the bony structure itself is never invaded, but becomes necrotic by the interference with its blood supply. The same may be said of the ligaments and cartilages.

"The ligaments are changed either in their structure or in their direction, and play an important part in the production of permanent immobility of the joint. The alterations they undergo have been well described by Hônécqne. The first thing is a sero-gelatinous infiltration which forthwith takes place in the interstitial cellular tissue, and then soon invades the laminated fibres of the fibrous tissue, which swell up and lose their pearly aspect. All or part of the ligament seems transformed into a soft, translucent, lardaceous mass in which one may recognise a marked cellular proliferation. There results from this a production of an abundant laminated tissue, having the same characteristics as cicatricial tissue. The ligament loses its form and

its boundaries, and one often finds oneself greatly embarrassed at operation to tell where the ligament begins and where it ends.

" Besides the fibrous degeneration of the ligaments an osseous degeneration takes place. The ossification takes place at the expense of their tissue, and one can find, it may be, osseous stalactites longer or shorter, it may be isolated plaques, it may be finally a 'muff' which solidly unites the articular surfaces." (Lagrange. *Traité de Chirurgie*, 1901.)

The Cartilage.

The behaviour of the cartilage is especially interesting and has been the subject of much discussion. König attached great importance to the precipitation of layers of fibrin from the joint exudate upon the cartilage, and to their subsequent organisation and tuberculous infiltration. This "tuberculous pannus," extending inward from the margin, was supposed then to play a great part in the subsequent erosion and destruction of the cartilage. In fact, the role accorded by König to the exudate in the joint is the principal one in synovial disease, and through it in the cases with bony focus he believes that the synovia is affected.¹ He evolves his pathology of the entire joint from the formation of the exudate. In this we believe that he and his followers are in error. We regard the exudate as a mere symptom, and hold that it plays a very small part in the extension of the disease. In a few of our specimens layers of fibrin have been observed on the cartilage and on the synovial membrane, but generally they appear to be an effect and not a cause.

Schlabowski found that the overgrown synovia was sometimes adherent to the cartilage, and, when separated from it, left it roughened. This may be so in some cases, but often the overgrown synovial "pannus" simply lies upon the articular cartilage, hiding it almost completely from view, but not adhering to it.

The older anatomists were wont to describe the synovia as a pouch, lining the entire joint and extending over the cartilages. In fact it is a section of a tube, attaching to the cartilages at their margins. It runs a short distance out on their surface, and both at the surface and deeper in, the structure of the one is said to shade off gradually into that of the other. The transition from the branching connective-tissue cells of the synovia to the true cartilage cells is also a gradual one. In other words, there is no essential difference in the

¹ König. Ueber die pathologisch-anatomische Geschichte der Synovialtuberkulose der menschlichen Gelenke. *Centralbl. f. Chir.*, 1894, xxi, S. 497.

basic structure of the two tissues, and recent investigators¹ maintain that immobilisation causes the synovia to encroach upon the cartilage and to spread out over its surface, only to recede again when motion has been resumed.

Lack of function causes a tendency in the cartilage to revert to fibrous tissue.² We find, as one of the early evidences of the degeneration of the cartilage in tuberculous disease, an exaggeration of this phenomenon, an encroachment of the synovia and a distinct fibrillation of the cartilage itself. In the deeper portion the direction of the fibres is perpendicular to the surface, but more superficially the fibres run parallel to it, and in places are frayed out, with free ends. These frayed ends, in our opinion, must have been mistaken for deposits of fibrin. The transition from the fibres to the homogeneous cartilage structure is often so gradual that one cannot tell where the one ends and the other begins.

This observation concerning the fibrillation of the cartilage is not new. Schlabowski³ noticed the fibres running parallel to the surface, and the general fibrillation.

Sometimes this fibrillation seems to be the only evidence of the degeneration. At other times the cartilage is more or less broken up, as though the tuberculous tissue beneath were bursting through it. Defects can be seen in it, filled with inflammatory tissue. In some of our sections the cartilage at the sides is fibrillated, further in it is broken up, and still further its structure is blurred.

¹ Nathan: *Journal of the Am. Orthop. Assn.*, August, 1909; quoting Reyer, Fisher, Hammer, and Braun.

² "Die Oberfläche der Gelenkknorpel jugendlicher wie älterer Individuen ist zum grössten Theil frei von einer sie bedeckenden differentiellen Gewebsschicht. An den Rändern der Gelenkflächen aber werden die oberflächlichsten Knorpelschichten durch ein Bindegewebe mit sehr zahlreichen verzweigten fixen Zellen substituiert. Noch weiter gegen den Knorpelrand hin wird diese Bindegewebsschicht dicker und enthält bald mehr, bald weniger weit gegen das Centrum der Gelenkfläche vorgeschobene Gefässe. Währenddessen rücken die verzweigten Zellen so nahe an einander, dass zwischen ihnen nur schmale Leisten des Interzellulären Gewebes übrig bleiben. Auf diese Weise geht der Knorpel allmählich in die sogenannte Intima der Synovialmembran über. Diese ist aber nicht eine Zellschicht, welche die Gelenkkapsel auskleidet um am Rande der Gelenkknorpel irgendwo aufzuheben, sondern sie erhält ihr charakteristisches Gepräge dadurch, dass fixe, fibrillenbildende Bindegewebszellen hier dichter als in anderen Geweben neben einander liegen. Niemals bilden diese Zellen ein continuirliches, die Gelenkkapseln bedeckendes Lager, niemals berühren sie sich unmittelbar, wie das der Begriff "Endothel" in sich schliessen würde, sondern sie sind stets eingebettet in einen andersartigen, selbständigen interzellulären Gewebestheil, stets sind ihre Fortsätze und ihre Anastomosen mit tiefer gelegenen Zellen der Synovialmembran durch geeignete Methoden bald leichter in Querschnitten, bald leichter von der Fläche gesehen nachzuweisen. Die Zellen der Synovialmembran sind alle gleich werthig, und die sogenannte Intima gewinnt nur durch ihren besonderen Reichtum an Zellen eine gewisse Sonderstellung."

³ "Die grössere oder geringere Ausdehnung der Uebergangszonen des Knorpels in die Synovialmembran ist wesentlich von mechanischen Momenten abhängig. Sie finden sich vorzugsweise da, wo die Knorpeloberfläche mechanischen Insulten wenig ausgesetzt ist, und wo diese ganz fehlen—in fixirten Gelenken und abnormen Gelenkbildungen—bedecken sie die ganze Knorpeloberfläche. Andererseits gehen die Synovialzellen da, wo sie andauernd starken Druck und Reibung zu erleiden haben, in Knorpelzellen über, und zwar unter Einhaltung derselben Uebergangszonen, wie an den Rändern der Gelenkknorpel. Hermann und Tournoux wurden dadurch veranlasst, die Synovialzellen als modifizierte Knorpelzellen zu bezeichnen." Braun. *Deut. Zeitschr. f. Chir.*, Bd. 39, S. 60.

⁴ "In der Mehrzahl der Fälle war der Process schon so weit vorgeschritten dass die Grundsubstanz besonders zerfallen war; die einzelnen Fasern waren meist parallel zur Oberfläche oder ganz unregelmässig angeordnet. Oft war schon makroskopisch ein faseriger Zerfall des Knorpelgewebes wahrzunehmen." Schlabowski. Die Veränderungen des Knorpels bei tuberculöser Gelenkentzündung; *Archiv. f. klin. Chir.*, lxx, S. 762.

Occasionally we find a layer of inflammatory tissue lying on the surface of the cartilage, but tuberculous tissue in this situation is very rare.

We conclude from a study of our specimens that no serious damage is ever wrought to the joint cartilage in tuberculous disease except that which is done indirectly by the involvement of the subjacent

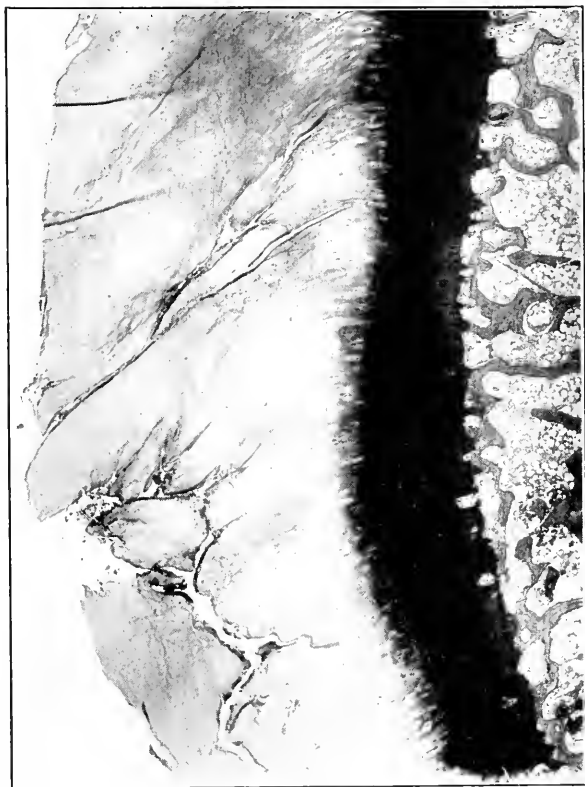


FIG. 15.—Synovial tuberculosis; section from the patella, showing fibrillation and breaking up of the articular cartilage; $\times 20$ diameters.

bone marrow. If the nutrition of the cartilage have been impaired by the disease in the bone beneath, motion will erode it and wear it away. If, on the other hand, its nutrition be not impaired, it may be found perfectly smooth and apparently normal, even when its surface has for years been exposed to a tuberculous synovial exudate.

König¹ denied any activity of the cartilage in the tuberculous inflammation. He maintained that it showed only degeneration.

¹ König. *Die Tuberculose der Knochen u. Gelenke.* Berlin, 1884.

Orth, while admitting that the cartilage cells might show a proliferation, is of the opinion that this is only preliminary to degeneration.

Rudolf Böhm¹ assigned to the cartilage cells not only retrogressive but progressive changes. Weichselbaum² held similar views.

Heile³ observed "tailed" and "horned" cells break their way into the cartilage, and concluded that the spindle-shaped cells which others had observed and had thought due to change in the cartilage cells were only the result of proliferation of the granulation tissue.



FIG. 16.—Fibrillation of cartilage; granulation tissue pushing its way through.

Schlabowski⁴ concludes that the cartilage shows active changes in the tuberculous inflammation, and that it takes part in the production of the granulation tissue.

Lagrange⁵ states that the cartilage is always diseased in joint tuberculosis, but always secondarily.

¹ Böhm. Dissertation, Würzburg, 1868.

² Weichselbaum. Die feineren Veränderungen des Gelenkknorpels bei fungöser Synovitis und Caries der Gelenkenden. Virchow's Archiv, Bd. 78, S. 461.

³ Heile. Virchow's Archiv, Bd. 163, 1901.

⁴ Schlabowski. Archiv f. klin. Chir., lxx, S. 762. From this article the four preceding opinions are taken.

⁵ "Le cartilage est toujours malade dans les arthrites fungueuses tuberculeuses; mais il l'est toujours secondairement."

"Les érosions décrites par Brodie, la nécrose primitive des cartilage signalée par Broca (Bulletin de la Société anatomique t. 26, p. 165) les altérations velvétique développées surtout au centre du cartilage étudiées par Redfern, sont dans tout les cas des lésions consécutives à la tuberculose osseuse sous-jacente ou, plus rarement, à l'action des fongosités nées dans les parties molles." Lagrange. Traité de Chirurgie, vol. iii.

Upon opening a tuberculous joint we may find the cartilages smooth and apparently normal, especially in synovial disease in its early stages—sometimes also in its later course—but as a rule in synovial disease an erosion occurs which begins at the sides of the cartilage and spreads inward. In bone disease the cartilage over the affected bone is mottled, thinned, and more or less eroded in spots. Sometimes, on the other hand, the smooth cartilage will give no idea of the extensive bone disease beneath it.

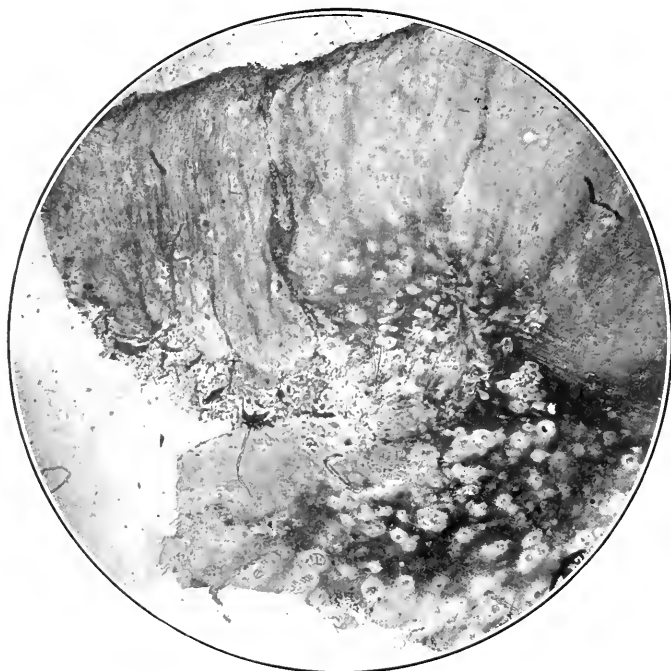


FIG. 17.—Badly degenerated cartilage.

Through all our specimens the entire pathological process can be translated as nature's effort to abolish function, to deprive the joint of motion. As we have already mentioned, this is never successful in adult joints. The ankylosis is always fibrous, and therefore motion is always possible.

This attempt to abolish motion in the joint is suggestive. We regard it as nature's effort at cure, and in our earlier work were wont to ascribe to motion in a joint the causative role in joint tuberculosis. Further study convinced us that, while our theory contained a germ of the truth, it could not cover all the phenomena of bone tuberculosis,

and that some other cause must be sought. We found this in the histological structure of the joint tissues.

The bone structure itself, the trabecula, is never involved in the tuberculous process either early or late. It, as well as the cartilages and ligaments, escapes tuberculous invasion, and, like them, suffers only by interference with its nutrition. All three structures in my opinion play a purely passive part in the disease. Virchow's original definition of a tubercle confined it in its occurrence to connective tissue, but there must be some peculiar element in the connective



FIG. 18.—Old calcified tubercle in bone.

tissue that renders it liable to invasion. Not all connective tissue is vulnerable. Primary involvement of pure fibrous connective tissue is very rare, if it ever occurs. Bone structure proper in the last analysis is connective tissue plus lime salts, while cartilage is a fibrous structure plus a cement substance. Many of our specimens show this fibrous structure clearly. The synovial membrane is also a connective-tissue structure.

In bone tuberculosis, the only tissue that is affected directly by the disease is the marrow, and in the marrow the disease spreads, not in the ordinary yellow or fatty marrow found in the shafts of the long

bones, but in the red or lymphoid or cellular marrow of their cancellated ends (and in the red marrow of the vertebræ, of the short bones, of the sternum, of the ribs, and of the cranial diploë). This is the reason why tuberculosis in the long bones almost always begins in the vicinity of the joints.

Why the cells of the red marrow should be especially vulnerable to tuberculosis is a question which we shall not take up here; but we hold to this highly important generalisation; *where red marrow is found in bone, the bone is subject to tuberculous infection; and where it is not found, there the bone is immune, or almost immune, to a purely tuberculous infection.* The important practical conclusion to which this generalisation leads is this: any procedure that causes the epiphysis of the long bone to lose its cancellous structure and to become compact bone, in other words, any procedure that changes the red or cellular or lymphoid marrow to the yellow, will cause the disappearance of the disease at that spot.

Hitherto, many writers have called attention to this vulnerability of the epiphyses of the long bones, and have attempted to explain it on various hypotheses, but no explanation has ever generally been accepted. Some have said that it was due to the greater blood supply; but an abundant blood supply has been shown to lessen the vulnerability of a tissue. Others claim that congestion following a strain or injury is the cause; but congestion (Bier treatment) is one method advanced for healing the disease, and all investigators¹ admit that severe injuries such as fractures and dislocations are not followed by joint tuberculosis.

Others, again, would have us believe that this susceptibility is due to the peculiar arrangement of the blood vessels. Before the ossification of the cartilage there is little arterial anastomosis, if any, about the epiphyseal line. There are two distinct objections to this theory; first, joint tuberculosis occurs in adults, in whose epiphyses an anastomosis is said to exist, and second, as far as I know, this lack of anastomosis is not regarded as a cause of tuberculosis anywhere else in the body.

Our explanation is simple and comprehensive, and goes far to clear up many facts hitherto regarded as obscure.²

This primary involvement of the epiphyses of the long bones is

¹ Krause, König, *et al.*

² The frequency of the disease in children, for instance. In children the bone contains more red marrow. On the other hand, with increasing age the synovial form becomes more frequent, and the bony form less frequent. In children under one year of age the epiphyses of the long bones are composed almost exclusively of cartilage, and in them tuberculous disease is very rare. In many text-books one sees the statement that tuberculosis is frequent in growing bone on account of the active blood supply; but other tissues are growing fast at the same time. Why are they not also affected?

perhaps not absolutely invariable. König describes a form of the disease involving the shafts. Possibly some cases of this are really the results of a mixed infection. Küttner¹ writes of a rare form of tuberculosis of the diaphysis of the long bones (especially of the radius, ulna, and fibula). He says that it is confined in its occurrence to children under six years of age. In an examination of 2127 cases of tuberculosis of the bones and joints of the extremities, he found only six cases of tuberculosis of the shafts of the long bones.

The occurrence of tuberculosis in the shafts of the long bones in children bears out our theory. Red marrow is found in this location in childhood.

Of the synovial membranes, classed among *structures of the lymphatic system*² the smooth fibrous portions are probably not the ones liable to primary invasion, but rather the fringes in the recesses of the joint, where there is found a distinct epithelioid covering (Quain) or epithelium (Gray), and where the smaller non-vascular, secondary fringes of Rainey (synovial villi) consist for the most part of small round cells with granular protoplasm. Throughout the body it is the connective-tissue structures containing epithelial, epithelioid, or lymphoid cells that are prone to invasion by tuberculosis, and the tissues of the joints are no exception to this rule.

We hold that any operation which deprives the synovial membranes of function causes them to lose their distinctive structure, and to change into fibrous connective tissue, and hence cures the tuberculous disease in them. We shall discuss this subject more fully later.

Involvement of Neighbouring Structures.

When the tuberculous granulation tissue has made its way through the capsule it attacks all the neighbouring structures that are vulnerable, the tendon sheaths, bursæ, etc., and this involvement of the par-articular tissues increases the swelling, and limitation of motion, and, probably by interference with the circulation, gives to the joint a swollen, pearly, pale appearance that is responsible for the name of "white swelling." The whole mass has a doughy, boggy feel. This condition is more or less characteristic of the cases with the slow, fungous proliferation of the synovia, and is seen in its most pronounced form in the knee and in the elbow.

"If the process gradually extends through the synovial membrane, foci of granulation tissues and abscesses develop in the 'parasynovial' tissues, which may later rupture through the skin and lead to the formation of fistulae.

¹ Küttner. Beiträge zur klin. Chir., Bd. xxiv, Heft 2.

² Quain's Anatomy.

"The reactive changes occurring in the surrounding tissues also belong to the anatomical picture of joint tuberculosis. These changes affect the connective tissue and the periosteum. All the soft tissues, the joint capsule, the ligaments, tendon sheaths, likewise the subcutaneous connective tissue, are transformed by the chronic hyperplastic inflammation into firm cicatricial masses." (Lexer-Bevan. General Surgery.)

One of the earliest symptoms of joint tuberculosis is an atrophy of the affected limb. In this atrophy all the tissues take part. The muscles shrink in size, and the bones become smaller and more fragile. At first the growth of the epiphyses entering into the formation of the diseased joint is stimulated in growing children, and the limb is actually increased in length. This is especially true of the knee. Later on, the epiphysis often lags behind in growth, and eventually the affected limb is usually found shorter than the unaffected one.

Pels-Leusden¹ has made a study of this point in some thirty-four tuberculous knees, and has reached the following conclusions:

1. The difference in length of the two legs is best measured by the Roentgen rays.
2. During the florid stage of the disease the growth of the affected limb is usually stimulated, and the leg is longer than its fellow.
3. It is doubtful if this primary stage of increased growth is followed by a retardation; certainly this retardation does not always take place.
4. The lengthening affects chiefly the lower end of the femur, and is due to an increased growth of the epiphysis there.
5. The reason of this growth is probably an increased irritation of the epiphyseal line.

Tuberculous Abscesses.

These are collections of fluid, formed by the breaking down of tuberculous granulations, and containing serum, white blood corpuscles, and often smaller or larger pieces of dead bone, and dead soft parts. They are sterile except for the presence of comparatively small numbers of tubercle bacilli, and are formed in the cavity of the joint or in the bone itself.

When the abscesses originate in the joint they distend the capsule, and breaking through, usually at its weakest part, gain access to the extra-articular tissues. Now their course to the surface is determined by the line of least resistance and by gravity. Those from the spine follow along the fibrous planes, often for considerable distances, and present at a point far removed from the focus of disease. As they

¹ Pels-Leusden. Deutsche Zeitschr. f. Chirurgie, vol. li, No. 13.

approach the surface they become infected by pus germs, cause red-
dening, inflammation and necrosis of the skin, and break through.
Until secondary infection takes place they may at any time be absorbed
spontaneously and disappear, but when secondary infection occurs,
spontaneous disappearance is impossible.

"As a rule, a tuberculous abscess in bone is circumscribed, rarely
becoming larger than a hazel nut, and is separated from the surrounding
healthy bone by a connective-tissue capsule (abscess membrane).

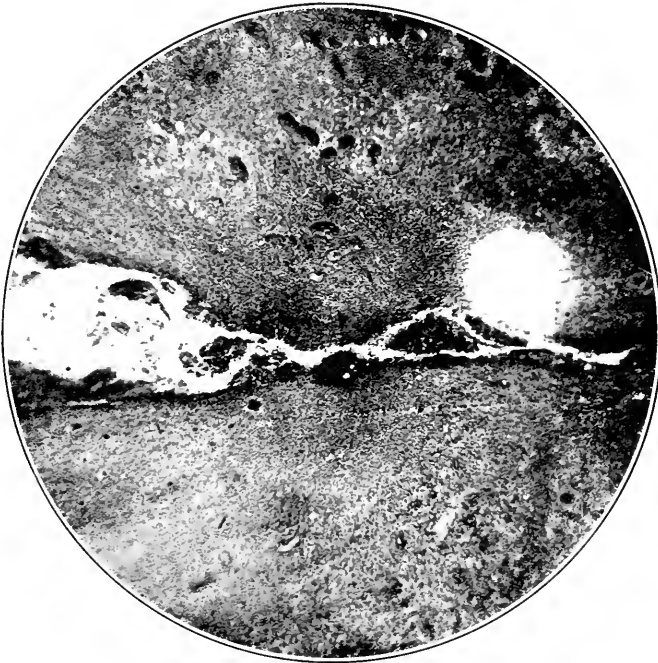


FIG. 19.—Uninfected tuberculous sinus. No tubercles were found in the walls of this sinus, but
the joint from which it came was demonstrated to be tuberculous.

Small bones, like those of the carpus, may be completely destroyed by
caries." (Lexer-Bevan. General Surgery, 1908.)

The walls of an uninfected abscess are composed of the fibrous or
muscular tissue through which it is working its way, sometimes necrotic,
occasionally showing the signs of active inflammation (oedema,
arterial thickening, round cells, polymorphonuclears, dilated capillaries,
etc.), but seldom if ever tuberculous granulations. There is no such
thing in these uninfected abscesses as a "pyogenic membrane."
The walls of an infected abscess or sinus are lined with tubercles, and

these tubercles may extend quite deeply. *The walls of an uninfected abscess or sinus are not tuberculous*, unless they are composed of some tissue that is vulnerable to unmixed tuberculosis, e.g., red bone marrow, synovia. *The walls of an infected abscess or sinus are tuberculous*. This fact has a direct and important bearing on the treatment.¹

Concerning the wall of these abscesses Park says: "This is the membrane formerly considered and called *pyogenic*, under the misapprehension that by it the pus or contents of the abscess were produced.

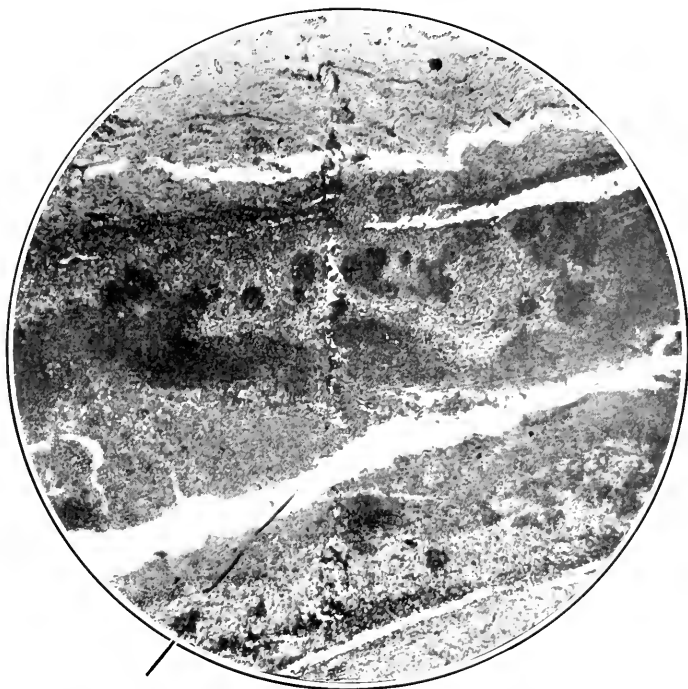


FIG. 20.—Cross section of old infected tuberculous sinus, showing tubercles in the walls. Contrast with Fig. 19.

I desire to emphasise in every possible way that this is a mistake. This membrane does not act to produce pus, but is rather the result of condensation of cells around the margin of the tuberculous lesion, forming, as it were, a sanitary cordon, for the absolute and definite

¹ "In regard to the questions which you ask regarding the tuberculous character of sinuses and tracts, I personally do not believe that such sinuses are commonly tuberculous. I have undertaken several times to ascertain whether or not they were, through histological examinations, and have failed. In short sinuses I do not much doubt but that one occasionally finds a redundant growth of granulation tissue, which comes from the centre of tuberculous activity and bulges out through the tract, but this is not a part of the wall of the tract. I personally have no confidence that there is such a thing as primary fascial tuberculosis." (Charles F. Painter.)
See also Ely. *Journal of the A. M. A.*, Oct. 8, 1910.

purpose of protection against further ravages." (With this last view we cannot agree. Author.) In Da Costa's *Modern Surgery*, 1910, p. 127, we find this: "The wall of the abscess is formed of compressed or solidified tissues. In a very recent case the wall is soft and will readily collapse. In an old case it is dense or actually fibrous, and will not collapse. This wall of compressed tissue is not, as used to be thought, a pyogenic membrane, which secretes the tuberculous material, but it actually surrounds the tuberculous material and hinders its diffusion."

Abscesses once infected may burrow in every direction, forming pockets in the tissues, and communicating with the surface by one or more sinuses discharging large quantities of foul pus. They form a serious complication, and add much to the dangers of the disease. Frequently the tuberculous granulations extend so deeply into the neighbouring tissues that these acquire a peculiar "porky" appearance and consistency. If they be removed by the curette or by the knife, they quickly re-form; hence the futility of the attempt at eradication.

There are two things which, although not exactly germane to our subject, may nevertheless with propriety be discussed here. The first is primary fascia tuberculosis, and the second, primary muscle tuberculosis.

Primary Fascia Tuberculosis.

The tendency to follow authority without any attempt at corroboration is well exemplified in the common use of this term. As far as I can ascertain, Nicholas Senn was the author of it in his book, *The Principles of Surgery*, published in 1901. In his second edition, in 1905, he reiterates his statements. On page 571 he says: "The bacillus of tuberculosis has a special predilection for fascia." He based his statements on two cases of cold abscess of the thigh. These he opened, and, because he found no bone defect, he inferred that they were primary in the fascia. He considered "Fascial tuberculosis affecting the inter-muscular septa of the thigh as an exceedingly grave form of local tuberculosis." Naturally it would be if its primary seat were ignored, and if by operation one infected secondarily one's cold abscess. From the description of his cases, it is probable that the abscesses were of the dissecting kind that occur in cases of Pott's disease. In such cases, as is well known, it is almost impossible to find the opening that leads up to the spine, but a careful examination will reveal almost always the spinal disease.

J. E. Moore, of Minneapolis, followed Senn. In the *Journal of the*

American Medical Association, August 12, 1899, he published six cases, *most of them secondarily infected*, and unaccompanied by any proof of their tuberculous nature.

J. Clark Stewart (Journal of the A. M. A., May 25, 1901) publishes five cases of fascia tuberculosis—*all with secondary infection*. He says: "Under this head I include all cases of primary tubercular infection of the fascia and those cases of fascial tuberculosis *secondary to adjacent tuberculosis*, in which the fascial involvement is of such an extent as to overshadow the original trouble."

On such insufficient evidence as this has been built up the clinical entity of primary fascia tuberculosis. Because the operator is unable to find the source of a tuberculous cold abscess, he is not justified in assuming its fascial origin. I have seen this diagnosis made once at operation. The succeeding microscopical examination failed to reveal any signs of tuberculosis in the specimen. I doubt if primary fascial tuberculosis exists. Certainly its existence has never been proved. Possibly, as Freeman intimates,¹ the pus in these fascial planes may have its origin in broken-down lymph nodes.

As to primary muscle tuberculosis, Virchow and Rokitsansky denied its existence. Many cases have been recorded, but a large proportion of these is not authenticated. Frida Kaiser² has carefully investigated the subject, and finds only seventeen authenticated cases published. To these she adds the eighteenth.

These are the recognised cases:

CASE 1.—O. Habermas. Beiträge zur klin. Chir., 1886, Bd. II, S. 70.

CASE 2.—Müller. Beiträge zur klin. Chir., 1886, Bd. II, S. 489.

CASE 3.—Reverdin. Revue medicale de la Suisse romande, 1891, No. 8.

CASE 4.—Lanz and de Quervain. Arch. f. k. Chir., Bd. 46, 1893.

CASE 5.—Lanz and de Quervain. Arch. f. k. Chir., Bd. 46, 1893.

CASE 6.—Lanz and de Quervain. Arch. f. k. Chir., Bd. 46, 1893.

CASE 7.—Lanz and de Quervain. Arch. f. k. Chir., Bd. 46, 1893.

CASE 8.—Lejars. Congres de Tuberculose, 1893.

CASE 9.—Rosenfeld. Dissertation, Königsberg, 1895.

CASE 10.—Morestin. Bulletin de la Société anatomique, 1896.

CASE 11.—M. R. Hemery. Thèse de Paris, 1897.

CASE 12.—M. R. Hemery. Thèse de Paris, 1897.

CASE 13.—Lejars. Revue de la tuberculose, 1899.

¹ Tuberculosis. Edited by Arnold C. Klebs. D. Appleton and Co., 1909.

² Frida Kaiser. Zur Kenntniss der primären Muskeltuberculose. Archiv f. klin. Chir., Bd. 77, S. 1033.

CASE 14.—Steinbach. Dissertation, Leipzig, 1901. Ueber primäre Muskeltuberculose.

CASE 15.—Zeller. Beiträge zur klin. Chir., 1903, S. 633.

CASE 16.—Zeller. Beiträge zur klin. Chir., 1903, S. 633.

CASE 17.—Lejars. Semaine medicale, 1, Juin, 1904.

The diagnosis is so improbable and so difficult to make, that one is justified in refusing to accept it unless it be confirmed post mortem.

The Pathogenesis of Bone Tuberculosis.

We are now in a position to formulate a theory for the occurrence of bone tuberculosis; the tubercle bacillus (or many bacilli), gaining access to the body through whatever port of entry, is carried in the lymph channels to a node, where the battle for its destruction begins by the lymphoid cells. If the fight be a successful one the bacillus goes no further, if not, then the bacillus leaves the node, accompanied by its natural antagonist, the lymphocyte.

The fight may be resumed at the next lymph node, or, if there be no other node intervening, the bacillus and the lymphocyte (or lymphocytes) reach the circulating blood. When through the blood these reach the red marrow of the bone they meet with another one of nature's protective mechanisms, a tissue rich in lymphocytes, and the battle is on afresh. The lymphocytes gather to the attack, and form the initial tubercle. If the lymphocytes prevail, the disease probably is cured without ever causing any symptoms, if not it goes on to what we recognise as joint tuberculosis.

Viewed in this light, joint tuberculosis is the result of nature's effort to rid herself of the disease, and is essentially an excretory process; but on this theory many phenomena of tuberculosis cannot be satisfactorily explained—why, for instance, the tubercle bacillus can thrive in a tissue rich in cells which are supposed to be intended for its destruction, while in other tissues, such as yellow marrow and muscle, it cannot exist unless there be a secondary infection. On this theory, also, the cure of a tuberculous joint after operation would be hard to explain, for the very tissue that is supposed to be rich in elements for destroying tubercle bacilli, disappears.

Without seeming to be rash I would propose the following hypothesis. The accepted relation of the lymphocyte to the tubercle bacillus is at least not invariable. If we may assume a different one, the whole problem of the occurrence of tuberculosis in the joints and in some other tissues becomes a simple one. It is an attractive field for speculation.

Let us assume that the lymphocytes and certain other similar cells are, not nature's defensive organism, but the natural food of the tubercle bacillus. The bacilli, floating in the blood, are thrown out into the various tissues. Where the bacilli find cells suitable for their growth, they live; where they do not find these cells, they die. Nature's protective mechanism is only the elaboration of toxins and the production of fibrous tissue. The relation of the tubercle bacillus to the lymphocyte, in other words, is the same as that of the gonococcus to the polymorphonuclear or of the malarial plasmodium to the red cells.

An operation that causes the disappearance of red or cellular or lymphoid marrow in the ends of the bones, shuts off the food supply of the bacilli. The bacilli can find no food in yellow marrow, but, if a secondary infection be added, the resulting suppuration furnishes the supply of cells peculiarly adapted to the growth of the tubercle bacilli, and tuberculosis invades the yellow marrow also.

I will carry the theory no further; to me it appears to explain almost everything, but its value depends entirely upon the correctness of our hypothesis.

CHAPTER III.

SYMPTOMATOLOGY.

The five cardinal symptoms of joint tuberculosis are *pain, disturbance of function, muscular spasm, limitation of motion, and muscular atrophy*. Others are swelling, change of contour, deformity, abscess, and those arising from secondary infection *e.g.*, fever, emaciation, amyloid degeneration of the viscera, etc.

Pain.—Usually the first symptom of the disease is *pain*, varying in intensity from a slight feeling of discomfort or stiffness, or an ache, to severe and agonising paroxysms. At first it is wont to be more or less intermittent in character, and is notoriously worse when the joint is first used in the morning, growing less during the day. Often the pain comes on during the night, and wakes the patient suddenly. He cries out, awakens, and immediately goes to sleep again—*night cries*. Later, as the disease progresses, the pain is more or less constant, and is aggravated by motion.

The pain may be felt at the location of the disease, or, in disease of the spine or hip, at another region whose nerve supply is the same as that of the affected joint—referred pain. During the formation of an abscess, while the contents are still under pressure, the pain is aggravated. When the contents have found access to the soft parts it grows less.

Sensitiveness to pressure will usually be present if the disease be superficially located, and if it can be reached by the examining finger, but it is not always a reliable symptom.

Disturbance of Function.—Coincident with the pain or appearing shortly after or before it, impairment of the function of the diseased joint takes place. If the trouble be in the lower extremity this impairment of function will manifest itself in a limp, if in the upper, the arm or hand will be more or less disabled, if in the spine, the patient will have difficulty in bending, turning the head, stooping, etc.

Muscular spasm is one of the early and most significant physical signs, and one of the last to disappear. It represents nature's effort to hold the joint surfaces at rest, and is responsible for much of the stiffness and pain of which the patient complains, and also for the impairment of function and for the deformity. Formerly regarded as a

pernicious symptom to be actively combated, like the pain and the disturbance of function the muscular spasm should be rather viewed as the evidence of nature's attempt at cure—as a conservative process. Muscular spasm is more pronounced in the bony type of the disease than in the synovial.

Limitation of Motion.—This ranks with muscular spasm as an early physical sign, and is due in part to it and in part to the infiltration about the joint, and to the change of structure in it. At first merely a restriction at extremes, it later increases, and finally may amount to a complete absence of motion. When due to muscular spasm it disappears upon the administration of an anæsthetic, when due to anatomical changes it remains even under complete narcosis.

Muscular atrophy appears early and is important from a diagnostic point of view. Its genesis has not been quite satisfactorily explained. It is partially the atrophy of disuse, but we do not yet understand why the early atrophy found almost invariably in joint tuberculosis, especially of the bony type, should exceed in amount that caused by other lesions of the joint. Possibly this also is a conservative symptom, another evidence of nature's attempt to put the joint at rest. Later on, the involvement of the tendon sheaths in the tuberculous infiltration may account for a part of it, but in the early stages this involvement does not take place.

In the later stages of the disease this atrophy, especially in untreated cases, or in those treated by methods which prevent function in the limb, is of extreme degree, but on the other hand, in hip disease treated by the method of weight-bearing and the short spica, sometimes one sees an actual increase in size of the calf on the affected side, probably from the extra work it is called on to do.

Swelling and change of contour can be distinguished early if the joint be near the surface, but if it be deeply located, as, for instance the hip or the spine, they will be apparent only in the later stages, if at all. These objective symptoms are caused by the exudate and by the tuberculous granulation tissue within the joint, and by the infiltration of the structures in the neighbourhood, and not, as would appear in a superficial examination, to any increase in size of the bone ends themselves. The swelling in time tends to assume the classical, fusiform shape in the joints of the extremities, and is accentuated by the atrophy of the muscles above and below the joint. According as the amount of fluid or of granulation tissue predominate, the swelling will be fluctuating or boggy. In some cases, especially in the shoulder-joint, swelling will be of small amount or altogether absent. Later in the disease swelling may be increased by abscess formation.

Deformity may be said to be the sum of the muscular spasm, the swelling, the change of contour, the atrophy, and the bone destruction. In the early stages it may be very slight and may only be distinguished by careful inspection and measurement. Later, in untreated cases, the deformity may attain great proportions.

Abscesses, as we have seen, are the result of the breaking down of tuberculous granulations, and are therefore usually a late symptom. If uninfected and of small size, they may cause no symptoms, and are discovered only by careful examination as fluctuating masses deep in the tissues. If infected they give rise to the symptoms of the ordinary abscess, *i.e.*, pain, fever, etc. If of large size these cold abscesses cause symptoms of pressure in the structures in which they are located.

An abscess that has ruptured or that has been opened by the knife and has been drained, almost invariably becomes infected by pus germs, and takes months or years to heal. It communicates with the surface by sinuses whose mouths present a pale, puffy, unhealthy appearance, and which have a tendency to burrow in every direction.

Fever, Emaciation.—These are, as a rule, the result of a secondary infection. A slight increase in temperature may be present at any stage of the disease, but high, intermittent temperature is commonly found only after secondary infection, or after the involvement of the internal organs. Extreme high temperature usually is found only in the severe cases with secondary infection. Patients with simple joint tuberculosis, under favourable surroundings are often plump and in good condition throughout the entire course of the disease.

Amyloid degeneration, meningeal and pulmonary tuberculosis, etc., are all to be viewed as complications. Any one of them may be the direct cause of death. Amyloid is a frequent complication in cases in which suppuration has existed for a long time.

Tuberculous meningitis is most common in children, is invariably fatal, and may supervene at any stage of the disease, or long after the patient has been discharged as cured. It was formerly supposed to be especially common after operative interference, but according to modern authority this is not a fact.¹

Pulmonary tuberculosis is a frequent complication among adults, and is often the cause of death. Pulmonary disease has also been said to be more frequent after operation, but this also is doubtful.²

There is a form of joint tuberculosis which in its onset somewhat resembles inflammatory rheumatism. Pain and swelling appear in

¹ Bradford and Lovett, *Orthopaedic Surgery*.

² Bliroth with a material of 554 cases of tuberculosis in the 6 large joints of the extremities, compiled statistics of results of the various methods of treatment. The treatment in 101 of these was amputation, in sixty-three resection, and in 390 it was conservative. The percentage of deaths from phthisis in the three was almost the same; *i.e.*, 26.73, 26.98, and 28.72 per cent.

two or three joints, one after another. These symptoms clear up finally, and the process settles in one joint, and then runs its course as in the usual type.

Poncet has described a condition which he calls "Tuberculous Rheumatism," and has published his views in a number of articles. Their correctness has not been demonstrated as yet, and their value may be said to be still *sub judice*. Possibly the joint symptoms are the result of a secondary infection. Fayerweather (Journal of the American Orthopædic Association, February, 1909) gives the following excellent abstract of one of Poncet's recent essays on the subject:

"Pathogénie du Rhumatisme Tuberculeux, by A. Poncet, *Gaz. des. Hop.*, 1908, No. 88.

"This paper presents some general considerations tending to establish the fact that a large group of cases of "chronic rheumatism" are of tuberculous origin. It is largely abstracted from the author's contribution to a series of twenty-five volumes, by Chantemesse, Poncet, *et al.*, forming the 'Bibliothèque de la tuberculose,' at present in press.

"Clinical.—Just as in the case of gonorrheal infections, so in tuberculous patients the appearance of an arthritis is by the 'law of coincidence' to be attributed, in the absence of proof to the contrary, to an extension of the pre-existing infection. Such joint manifestations are very frequent in tuberculous subjects. It is not rare to see a joint of purely rheumatic appearance develop into one of the characteristic fungous type. Very suggestive, also, are the transient joint symptoms when, by heroic medication, the cough and expectoration are suddenly suppressed in chronic phthisis; or the increase or decrease in co-existing 'rheumatic' joint symptoms inversely with improvement or aggravation of the pulmonary conditions in consumption.

"Experimental.—Certain clinical procedures may yield evidence. The subcutaneous injection of Koch's tuberculin has produced arthralgia and acute synovitis. Lannelongue, using it for treatment of lupus, observed that it produced generalised rheumatic phenomena in an infant.

"Pathological and Bacteriological.—Results of recent researches collectively permit the classification of 'rheumatic' tuberculosis under three heads: *a.* With specific reaction. The synovial membrane is studded with granulations, ordinarily in association with fungoid changes, or pyarthrosis, but occasionally existing as an independent lesion. It is, however, a rare form. *b.* Without pathological, but with bacteriological specificity. The nature of the affection is demonstrated by production of tuberculous lesions in animals inoculated

with the joint fluid. Very rarely the tubercle bacillus is isolated directly from the joint. *c.* Without pathological or bacteriological proof of the tuberculous origin. This is much the largest class. Only isolated clinical features suggest the etiology, but in many cases these are so striking as to form a considerable chain of evidence, among them, the transformation of an ordinary 'rheumatic' joint into a white swelling or the reaction of such a joint to tuberculin. It is conceived that in such cases the changes produced in the joint have been purely inflammatory—para-tuberculous, comparable to the para-syphilitic of Fournier. It has been shown that attenuated tubercle bacilli can excite simple inflammatory reactions, and we can no longer adhere to the idea of the specificity of the tubercle itself, this being only the most highly differentiated of the lesions produced. This fact has been fully established by different observers in regard to the action of the bacillus on a variety of the body tissues, such simple inflammatory reactions being styled by Bernard and Gougerot 'nonfollicular lesions,' and by Poncet, 'inflammatory tuberculosis.'

"Considering this inflammatory form fully demonstrated, Poncet discusses the mode of its production. Some would hold the lesions to be the result of secondary invaders—bacillus coli, streptococcus, etc. 'Have these been demonstrated *in situ* or in the blood of tuberculous rheumatics?' 'Are vultures on the field of battle the victors because they appear after the defeat?' The reaction in the joints may be due 1, to diffusible toxins produced by tubercle bacilli in a distant focus; 2, to 'adherent toxins' produced *in situ* by attenuated bacilli; 3, to direct action of attenuated bacilli so few in number as to escape any but the most scrutinising search. It is impossible yet to determine, but the last is the probable mode of action. The important fact remains, however; the tuberculous origin of the 'rheumatism.'"¹

¹ For articles on Poncet's tuberculous rheumatism see the following:

Melchior. Berlin. klin. Woch., March 14, 1910.
 Munoz. Rev. de Medec. y Chirurg. pract. de Madrid, No. 1092, v. 28.
 Poncet et Leriche. Revue de Chirurgie, Jan., 1909.
 Arnaud. Revue d'Orthopédie, Nov., 1908, p. 511.
 Patel. Revue de Chirurgie, 1901, p. 801.
 Bonveyron. Revue de Chirurgie, 1902, p. 329.
 Melchior. Die Therapie der Gegenwart, April, 1909.

CHAPTER IV.

DIAGNOSIS.

The History.

In making the diagnosis in a suspected case of joint tuberculosis, it is well to go about the work systematically, and to note down everything that bears directly or indirectly on the case. Sometimes we shall receive help in our task from some apparently irrelevant point. The age of the patient should be noted and his occupation. Tuberculosis should be sought in his family history, and tuberculosis or any other infectious disease in his own previous history.

An adult should be questioned as to gonorrhœa and syphilis, carefully yet tactfully. A history of trauma should be sought, and the relation of it to the symptoms in point of time. The notorious tendency to ascribe all disease of this kind to an injury must be borne in mind. Therefore, one should learn the interval elapsing between the trauma and the onset of the symptoms, and whether the patient was perfectly well at the time of injury. To be connected in any way with the injury, the onset of the disease must be within a few weeks of its occurrence, and if, as is often the case, some symptoms were present previously, the injury is only to be regarded as aggravating the trouble.

One ascertains whether the symptoms began suddenly or gradually, if they are increasing in severity, stationary, or lessening; if any other joints have been involved. All these things are important, and yet one must be prepared at times to disregard almost everything in the previous history and must make the diagnosis on the objective symptoms alone. Indeed, a history of a child furnished by a parent, at second hand, so to speak, is more reliable than that given by an adult of his own case.

Physical Examination.

The attention is next turned to the patient himself. While he is removing his clothes his general condition is noted, and any peculiarities in his attitude or gait. A child should invariably be stripped, and a careful examination of him should be made from head to foot. One searches for enlarged lymph-nodes, for old scars, and for anything

abnormal in each joint in the body, not forgetting the entire spine. All the joints are put through their entire range of motion, and any sign of limitation, sensitiveness or muscular spasm is carefully noted.

To this rule of completely stripping a child there should be no exception. Only in this way will one save oneself from humiliating mistakes. The old error of inspecting only the knee in early hip-joint disease is but one of many errors that are often made.

In an adult male the same rule may be followed, although usually he will call attention to any region of his body that occasions discomfort. At any rate, if one of his lower extremities is affected, all his clothes below his waist must be removed, and then we shall find inspection of his spine easy by lifting his shirt. If the suspected joint be in the upper part of his body he should be stripped to the waist, at least. For the inspection of a woman, most of her clothes may be removed if she be covered with a sheet.

Often the surgeon will incur blame because he has neglected to find something that no one had suspected, while, again, many a diagnosis that passes for brilliant owes its correctness simply to attention to details and to methodical thoroughness.

Any abnormality in the attitude, appearance, or function of a part is noted; any swelling, change of contour or consistence, limitation of motion, sensitiveness, discolouration, or atrophy. In the case of the lower extremity the length of the limb and of its fellow is measured with a tape, also the circumference of the thighs and calves. The range of motion of the affected part is ascertained in degrees, either roughly by the naked eye, or with a goniometer.

As a rule, all necessary manipulation can be made with the slightest amount of pain or with none at all. It is not advisable to strike the patient forcibly upon the head or heels. There are some children (and some parents) so refractory that their examination will always be unsatisfactory, but if one use tact and patience one will find their number very small. Sometimes a postponement to another day will soothe their fears. One should make it a rule never to inflict pain on a child if it can possibly be avoided, and never to deceive him, especially if he is to be seen again. Frequently a running fire of remarks well interspersed with questions will divert his attention completely.

Occasionally a child is met who objects strongly to the removal of his clothes, but if the clothes be admired and an inspection of them be requested, he will part with them readily. Most boys resent the title of "my little man."

The general attitude of a child who is brought for examination is one of suspicion, especially if he has previously been roughly handled;

and this attitude must be changed if we would succeed in our task. Once a child's confidence is gained, the rest is easy. All these things may seem unimportant, but they really count for much.

The Röntgen Rays.

A good *x-ray* plate will often be of service in the diagnosis, but it should only be used as confirmatory evidence. A negative skiagram should never outweigh a positive clinical opinion, but a definite lesion showing in the plate is, of course, of more value against negative physical



FIG. 21.

FIG. 21.—Syphilitic osteitis. The diagnosis was clinical only. The patient reacted to anti-syphilitic treatment. The joint was not involved. It would be difficult to make the diagnosis on the skiagram.



FIG. 22.

FIG. 22.—Syphilitic osteitis. Side view of preceding.

signs, and one should always remember that the interpreting of *x-ray* plates requires considerable experience and is a subject of marked individual differences of opinion. This is not to be understood as a recommendation to turn over the making of a diagnosis to a radiographer. This is a responsibility which rests upon the surgeon

and of which he cannot divest himself. He may or may not accept the radiographer's opinion. If he does accept it he is none the less responsible for the outcome of the case.

Skiagrams of synovial tuberculosis are often of little use. A small, diffuse infiltration in the bone marrow can easily escape recognition, before the nutrition of the trabeculae has been affected, but a well



FIG. 23.



FIG. 24.

FIG. 23.—Tuberculous elbow after about 18 months of treatment by plaster of Paris. Note disorganisation of joint, erosion of cartilage, and areas of rarefaction and condensation of bone.

FIG. 24.—Same case as Fig. 23, side view. Note the atrophy of the humerus. Patient about 25 years old. The pictures of this elbow may be said to be more or less typical of joint tuberculosis.

defined bony focus can often be distinguished as a dark area on the plate.

The x-ray picture of a case of typical bone tuberculosis is precisely what one would expect from a study of the pathology, and if one will bear the pathology in mind, one will find the interpretation of the skiagram comparatively simple. The tuberculous granulations in-

terfere with the nutrition of the bone trabeculae, and enable the rays to pass through more easily; hence the dark spot on the plate. The irregular distribution of the tuberculous granulations gives to the lesion a "worm-eaten" appearance. The succeeding atrophy of the



FIG. 25.



FIG. 26.

FIG. 25.—Tuberculosis of the head of the tibia in child about 4 years of age. Note sequestrum. This case had been diagnosed before operation as tuberculosis, infectious osteo-myelitis, and syphilis. The joint was not involved.

FIG. 26.—Side view. The black smear is mercurial ointment. The diagnosis in this case was made in the laboratory, by several pathologists. Clinically, the case was non-tuberculosis, and certainly the x-ray is not characteristic.

bone in the vicinity is responsible for the lack of sharpness in detail, and for the darkening of the shadow on the plate. If much productive osteitis have taken place, in the effort at repair, it will show in the plate as a light area.

Laboratory Diagnosis.

The various *tuberculin tests* are also of value, though one should always be prepared to disregard completely their results. A tuberculous lesion anywhere in the body can give a positive reaction, though the joint under consideration may be free from tuberculosis, while on the other hand, patients with tuberculous joints often fail to give the reaction.

The following description of the tuberculin tests, copied from a digest issued by the Cutter Laboratory, may be found useful:

TUBERCULIN TESTS.

The Calmette Test; Ophthalmic Reaction. Tuberculin—O. T.¹ (Purified) 1 per cent. Solution.

Wolff-Eisner and Calmette, working independently, were the first to suggest the conjunctival tuberculin reaction as a diagnostic test for tuberculosis. Calmette used a solution of tuberculin precipitated and purified by alcohol, the precipitate dried and made into a 1 per cent. solution.

The Test.—Draw the lower eyelid outward and downward, and drop one drop of the tuberculin into the conjunctival sac. The retention of the drop is facilitated by having the patient lie down or incline his head backward, the lower lid being held out from the eyeball. In the meantime the lid should be gently manipulated so as to distribute the tuberculin over all parts of the conjunctiva. If the patient will then close the eye for a few minutes the distribution is assured.

The Reaction.—From two to three hours after the instillation of the tuberculin there is a slight smarting sensation along the edges of the lids and at the inner canthus. This is soon followed by lachrymation and a feeling of stiffness in the lids of the affected eye. Examination of the conjunctiva at the end of three or four hours usually reveals a moderate degree of redness and swelling of the palpebral portion and of that at the inner canthus. The caruncle is slightly swollen. A delicate tracery of blood vessels appears on the ocular conjunctiva below the equator. In another hour or two there is a slight photophobia, and filaments of a thin, grayish-white fibrinous exudate may appear on the eyeball and over the palpebral conjunctiva. There is frequently a perceptible collection over the caruncle. There is more or less tenderness to pressure over the eyeball, but no pain. The vascular engorgement proceeds with moderate rapidity, so that at the end

¹ "Old Tuberculin."

of eight or nine hours the eyelids, especially the lower, are markedly swollen, the conjunctiva is deep red, velvety, with flakes or strands of the fibrino-purulent exudate on it. This exudate tends to pass toward the inner canthus, and may be seen as a grayish-yellow mass filling up the angle and covering the canthus. The engorgement of the vessels in the ocular conjunctiva is marked. A network of tortuous arteries is seen, with fiery red conjunctiva in the meshes. Lachrymation, photophobia, and tenderness over the eyeballs are increased. There is frequently a sensation of a foreign body in the eye. The burning and smarting along the edges of the lids become marked. Frequently itching and a desire to rub the eye are present. If scratching be allowed, it frequently prolongs the reaction and intensifies it somewhat, and develops more or less intense congestion of the conjunctiva.

The reaction reaches its maximum in six to fourteen hours after the instillation, and all traces of it disappear in two or three days. In the majority of cases even the disagreeable features of a rather intense reaction have passed in twenty-four hours. Sometimes the reaction may be very fleeting, appearing and disappearing in one day. If a reaction is not pronounced or if there is any doubt, a second instillation should be made in the other eye. The second test should not be made in the same eye.

It is the general opinion that a prompt reaction in a suspected case is evidence of the existence of tuberculous foci, yet the failure to obtain it at the first instillation cannot be held as evidence that the patient is non-tuberculous. If a positive reaction does not appear after two tests, then one is justified in holding that the patient is non-tuberculous. The eye not instilled is a control on the one tested, and a comparison of the two gives a reading of the reaction. The test produces practically no febrile nor constitutional disturbance. Calmette has recently claimed that in 10,000 cases already reported its harmlessness has been proved. It is advisable not to make the test in any other than the normal eye.

The Von Pirquet Test; The Cutaneous Reaction. Tuberculin O. T. (Dilution).

Von Pirquet of Breslau devised a method of diagnosing tuberculous infections by the application of a dilute solution of tuberculin as in ordinary vaccination. The test is very simple, and is attended by scarcely any pain and by no harm.

The Test.—The skin of the forearm at the point selected for the test is first disinfected by applying a little dilute solution of carbolic acid,

followed by alcohol, and then is dried thoroughly with sterile absorbent cotton. Then with a small sterile scalpel held perpendicularly so that the point only is in contact with the skin, three parallel and very superficial cuts or scratches are made about an inch long, and about an inch apart, and not sufficiently deep to draw more than a trace of blood. After putting the skin on a slight stretch at right angles to the cuts, a drop of the tuberculin is brought into contact with the two outer cuts and is gently worked in with the pipette. The middle cut is not inoculated with the tuberculin and serves as a control over the other two. The later appearance of the two outer cuts compared with that of the middle one gives a true reading of the reaction. Another method of applying the test is to make three very slight scarifications, as in vaccination, about $\frac{1}{4}$ inch across, and about an inch apart, on the forearm or arm. Then drop one drop of tuberculin on two of the three and gently rub in with the pipette. After about five minutes the remaining liquid is mostly taken up with a bit of absorbent cotton, and a light bandage is applied. The third scarification not inoculated serves as a control, and gives by comparison a true reading of the reaction.

The Reaction.—The diagnosis depends upon a local reaction. After eighteen to twenty-four hours a more or less well-marked papular erythema appears on the site of the inoculated cuts or scarifications, while the site of the control shows only a slight redness due to the trauma. If tuberculosis is not present the site of the inoculation, like that of the control, shows only the traumatic congestion. The size of the papule is commensurate with the intensity of the reaction. There is no temperature change, consequently the test can be used in fever cases also. It does not cause any constitutional disturbances. The test is trustworthy in all forms of incipient tuberculosis, and is especially adapted to children of two to five years old. It is not reliable in the far advanced processes, but here a diagnosis is determined by the characteristic symptoms.

A negative result is not conclusive evidence of the absence of a tuberculous infection. Such cases should be tested by other diagnostic tests (the ophthalmic test, or by tuberculin injection), or they should be carefully watched for future evidence of the disease, and the cutaneous test should be made at a later time.

The Moro Test. Tuberculin Ointment.

The ointment is a mixture of tuberculin (original) and sterile anhydrous lanolin.

Site for Test.—The location selected may be any convenient por-

tion of the body where the skin is thin, and where the test will give the least inconvenience. Such selected place may be the arm, the abdomen or chest. Perhaps the arm is the most convenient site, both for the patient and for the physician, as it is easily bared and is the least subjected to pressure or irritation from clothing.

The Test.—It is unnecessary to prepare the surface of the skin by any sterilising method, though it is recommended that it be washed with a little alcohol. The test does not require any scarification or other injury to the skin, so post-infections are not likely to occur.

A small quantity of the ointment is placed on the skin at the site selected, and then is thoroughly rubbed, by a circular movement, with a little pressure, for about a half minute and until it is uniformly spread over a circular area of 2 or 3 inches. The wearing of a sterile finger cot by the physician is advised.

A light gauze bandage should be applied to prevent any extension of the reaction by contact with other portions of the body, and to prevent any irritation and soiling of the clothing.

The Reaction.—If the person tested have any tuberculous infection, a positive reaction will be obtained in twelve to forty-eight hours, which is manifested by the appearance of a more or less intense papular or nodular eruption over part of the area of the inoculation or over it all. Various degrees of reaction will obtain, from a feeble one, characterised by a few reddish papules or nodules and some redness of skin, but no itching, to a marked reaction occurring in the first twenty-four hours, showing many red papules, reddening of the surrounding skin, and more or less itching. The reaction will persist for a few days.

A rather severe reaction sometimes occurs, developing in the first few hours. There will be seen very many quite red papules of varying sizes and much reddened skin over the entire area tested and sometimes beyond its border. There is also considerable itching during the first day or two. The entire reaction disappears in a week or two, leaving only a slight brownish pigmentation of the skin. The tested area should be protected with a light bandage to prevent irritation from external sources, and especially to prevent its being scratched when the test is made on children.

The test is perfectly harmless and causes no systemic disturbance, fever, pain, or discomfort.

The ointment is delivered at the sight of test by squeezing the capsule between the thumb and forefinger.

Microscopic Examination.

It is rarely advisable to make an exploratory incision into the joint for the purpose of diagnosis alone, and a microscopic examination of a piece of tissue removed from a joint is not always conclusive. In one resected knee in our possession, an operation had been done a year previously, and a portion of the synovial membrane had been removed. Under the microscope this exhibited no sign of tuberculosis, but appeared to be a typical case of so-called "villous arthritis." A thorough examination of the joint, resected later, showed an area of tuberculosis of the synovial membrane, under the margin of the patella, about one cm. in diameter.

The Animal Test.

If a piece of the tissue be removed for diagnosis it should not only be examined microscopically, but part of it should be ground up and injected into the peritoneal cavity of a guinea-pig. In case the joint contains fluid it may be aspirated under strict precaution, and the fluid may be injected into a guinea-pig's abdomen. If the fluid be tuberculous the guinea-pig will die of tuberculosis, but it is doubtful whether the serous effusion that accompanies the early stage of an osteal tuberculous lesion is itself tuberculous.

Leucocytosis is not ordinarily found in patients with uninfected tuberculous joints. Hence the value of a blood count in some instances.

With a good history, in most cases a correct diagnosis may be made readily on the clinical symptoms, x-ray findings, and the result of tuberculin tests (in the order of importance); in some the diagnosis will be much more difficult, while in a few it will be impossible. This statement is made not only on a rather long personal experience, but also on the observation of the work of others, with the opportunity of correcting conclusions by a further observation of the case and by the examination of the specimen in the laboratory.

It is well to keep an open mind even after a diagnosis has once been made, and always to be alive to the possibility of error. Doubtless many cases of so-called tuberculous joints that have recovered completely with perfect function are merely examples of incorrect diagnosis. The vogue of many systems of treatment is due to this cause.

It should be necessary in publishing statistics of cure, to publish also the facts in the cases on which these statistics were based; to prove, that is, not only the cure, but the diagnosis as well. *Restitutio ad integrum* probably does occur, but without doubt it is very rare, and

anyone who observes it in a case under his care should scrutinise rigorously his methods of diagnosis. Absolute statements are easy to make, but sometimes hard to prove, and many an elaborate system of treatment has been based upon the simple word of its author, without a pretence of proof.

Medical writings are full of errors at this day, which are handed on down unchallenged from one writer to another, until someone takes the trouble to investigate them and finds they are false.

Our laboratory examination of sixty-five joints, the results of which were published some time ago,¹ throws some light on this difficulty of diagnosis: In two cases the clinical diagnosis was not given; in thirty-nine tuberculous joints it agreed with the final laboratory findings; in six the laboratory diagnosis was tuberculosis, and the clinical, no tuberculosis or doubtful. In fifteen cases of joints operated on as tuberculous or without definite diagnosis, tuberculosis was not found in the laboratory.

This gives us 65 per cent. of correct diagnoses, and when we consider that several of these were assisted by a previous pathological examination the unreliability of the clinical diagnosis alone is even more apparent. In each case we have taken as the clinical diagnosis that made by the operator. In those cases where we have noted the various diagnoses of different men on the same joint the results have been even more startling. So disquieting were they, indeed, that we submitted the specimens to a second thorough examination, endeavouring to modify our conclusions, and to find tuberculosis where we had found none before. The second examination did not change the results of the first; and the cases clinically non-tuberculous, in which tuberculous tissue had been found, admitted of no change.

Now, it may be argued that tuberculosis may exist in a joint and may escape detection in the laboratory, and that if a joint is clinically tuberculous, it is tuberculous in spite of what it shows under the microscope; but to this the answer is, of course, that all our clinical classification, as well as our definition has been built up on laboratory findings, and that unless tuberculosis can be demonstrated under the microscope, the joint is not tuberculous. If no microscopic examination (or animal test) be done, we simply call a joint tuberculous because of its clinical similarity to other joints in which the characteristic tubercle has been demonstrated under the microscope.

We will admit, however, that as the appropriate stains have not been used to detect the presence of the tubercle bacillus, there may be a very small margin of error in our conclusions.

¹ Surgery, Gynecology, and Obstetrics, June, 1910.

Not only in the matter of diagnosis have errors been found in the statements made in the histories. Notes taken at the time of operation are not always reliable. One operator pronounced the bone soft and much "eaten away" because it broke in his lion-jawed forceps, but in the laboratory it proved to be quite hard. Another history gives the information that "scattered tuberculous foci" were found abundantly in the head of the bone. These "scattered tuberculous foci" proved to be small, white particles of cartilage that had been carried in on the saw, and no tuberculosis could be found in the specimen. It has been my experience that not all operators are eager to hear of their mistakes in diagnosis.

CHAPTER V.

DIFFERENTIAL DIAGNOSIS.

Syphilis of bone, an osteo-periosteitis, is of frequent occurrence; syphilis of joints, on the contrary, is rare. It is sometimes seen clinically as a more or less sluggish form of "synovitis."¹ Many a syphilitic bone disease has been treated for a long period with a diagnosis of tuberculosis.

The main points of differentiation are the greater tendency of syphilis to involve several bones and to produce bony thickening, its predilection for the diaphysis and its usual avoidance of the joint, the punched-out, sharply defined appearance of its sinuses, as opposed to the flabby, pale, pouting sinus of tuberculosis, and the boring nature of the pains.

The previous history may be of assistance, and an examination of the patient will often reveal well-marked signs of syphilis. The scars left by a healed syphilitic lesion are apt to be dark brown or copper coloured.

The x-ray shows a darkening of the bone shadow and a productive osteitis, while that of tuberculosis shows a thinning or perhaps a worm-eaten appearance of the bone—a rarefying osteitis.² If an infected sinus be present, a section of its walls will show under the microscope the ordinary signs of inflammation, but no tubercles.

A therapeutic test with mercury and the iodides is of use, but one must remember the beneficial effect of mercurial ointment upon tuberculous sinuses. The recent elaboration of the Wassermann and Noguchi tests, as well as the newer methods of staining the spirocheta pallida have somewhat simplified the problem.

Gonorrheal Arthritis and Periarthritis.—A gonorrheal joint may present an appearance not to be distinguished from that of a tuberculous joint, but the muscular spasm and the atrophy are wont to be less, the onset is wont to be more acute and is often synchronous with

¹ Lagrange (*Traité de Chirurgie*) says that the syphilitic hydrarthrosis comes on in the secondary stage, or somewhat later—two or three years after the initial lesion.

"In the tertiary stage a chronic serous synovitis may be present, accompanied by capsular thickening and a tendency to contraction and fibrous ankylosis. This may be due to the development of gummata in the perisynovial tissues, with chronic hyperplastic synovitis—and secondarily, the development of gummata in the bone, and a secondary affection of the joint." (Bradford and Lovett, in *Reference Handbook of the medical sciences*.)

² For an interesting description of x-ray findings in syphilitic bone disease see: Ware, *Annals of Surgery*, August, 1907. Ware, *Surgery, Gynecology and Obstetrics*, Jan., 1908. Also, *Interstate Medical Journal*, Jan., 1911, p. 145.

the florid stage of a urethritis (not always so, however, in children), the sensitiveness to pressure is usually greater, the tendency to involve several joints is more pronounced, and the temperature runs higher. Abscess formation is rare.

In an old gonorrhœal joint, in which the disease has run its course, there is little tendency to angular deformity, and practically no circumarticular swelling or infiltration. All that limits the motion of the joint are the adhesions within it. The *x*-ray in the early stages yields negative results; later the margins of the cartilages are blurred.



FIG. 27.—Bone syphilis; duration 4 or 5 months. Pain, sensitiveness, etc., but no involvement of joint. Distinct history of paternal syphilis. This child had shown other symptoms of syphilis.

Rheumatism.—The onset of a true articular rheumatism is acute, with fever, coated tongue, acid sweat, etc. The affected joint is puffy, swollen, red, and exquisitely sensitive to the touch. The disease flits from joint to joint, *leaving behind it no trace*. Endocarditis, pericarditis, and angina are frequent accompaniments. With no history and with but one examination a mistake might possibly be made, but not otherwise. Articular rheumatism is very rare in children, and even in adults is not a frequent disease. The common mistake of treating

for weeks and months as rheumatism a tuberculous joint is absolutely inexcusable.

Acute Infectious Arthritis, Acute Epiphysitis.—The arthritis accompanying the acute infectious diseases or immediately following them, notably typhoid fever, scarlatina, pneumonia, and grippe, begins acutely, with pain, high fever, and swelling, and rapidly proceeds to abscess formation. In some cases the specific organism of the disease can be recovered from the fluid in the abscess, which is true pus, and not the flocculent, broken down material of a cold abscess. The process is usually very rapid, and tends to destroy the joint unless operation be prompt—quite distinct from the insidious onset of joint tuberculosis, which may follow these diseases, but only after a considerable interval of time. Leucocytosis is present in infectious arthritis, not in simple joint tuberculosis.

Osteo-mylitis of the ordinary or infectious type. The acute onset, the high fever and marked constitutional disturbance, the freedom of the joint from invasion, the limitation of the process to the diaphysis, the thickening and sensitiveness to pressure of the latter, the severe boring and throbbing pain, the local œdema, and the leucocytosis should serve to differentiate this disease from tuberculosis. In osteo-mylitis due to the staphylococcus the course of the disease is slower and not so acute, but here also the joint is not affected. It may be said that ordinary or infectious osteo-mylitis affects the yellow or fatty marrow, while tuberculous myelitis affects the red or cellular marrow.

“**Chronic Synovitis**” is the name which attaches to a joint affection or group of affections, whose pathogenesis is as yet not clearly understood, and whose differentiation from tuberculosis is often quite difficult or at times impossible. Probably many cases to which this name has been given are, in fact, tuberculosis of the synovial type.¹

It is well to view with extreme suspicion any chronic serous joint effusion, until its non-tuberculous nature has been proved. The tuberculin tests may be of value, and more especially the injection of some aspirated fluid into a guinea-pig's abdomen. A microscopic examination of a clipping from the synovia may or may not be conclusive, for reasons already stated—tuberculosis can exist in one part of the synovia and not in another.

Because the disease has existed for years without seriously damaging the joint, one is not warranted in assuming its non-tuberculous nature. There is no such disease as “villous arthritis.” Enlarged villi may be

¹ “Chronic serous synovitis is much more frequently the result or symptom of some other disease of the joint than an independent clinical entity.” (Lexer-Bevan. General Surgery.)

present in any inflamed joint, tuberculous or non-tuberculous, or in hæmarthrosis. They are the sign of disturbed function in the synovial cavities—the result of disease, not the cause of it, though possibly in extreme cases they may become the source of mechanical irritation. Sometimes minute islands of cartilage may be found in them.

The diagnosis of *arthritis deformans* of the hypertrophic and atrophic types will be discussed under the heads of the special joints.

Scurvy—scorbutus—as we find it, occurs [usually in children under one year of age, bottle-fed, and especially in those children fed on condensed or sterilised milk. The patient cries on being moved, and some one joint will be found exquisitely sensitive. The disease comes on suddenly, and those suffering with it often have swollen, bleeding gums. Raw milk, perhaps in addition to fruit juice, will rapidly abate the symptoms, and so make the diagnosis clear.

Still's disease occurs exclusively in children, is essentially multi-articular, is characterised by enlargement of the liver, spleen, and lymph-nodes, and is often accompanied by blood changes. There is a more or less marked symmetrical tendency, and after the joints have swelled up, the symptoms in them become quiescent, and the pain disappears. "There is never any involvement of cartilage and bone in the Still's cases."¹

Charcot's Joint—Trophic or Neuropathic Joint.—The absence of pain, muscular spasm and limitation of motion, the evidences of disorganisation in contradistinction to inflammation, and the presence of the symptoms, history, and physical signs of a cord lesion will prevent error if one will but bear in mind the possibility of this disease. The knee is most frequently affected, then the ankle and then the hip. The x-ray may show broken masses of bone lying free in the joint.

Sarcoma of bone is fairly frequent at all ages. Its onset is fairly rapid, the pain may or may not be severe, the swelling is distinctly above or below the joint, and not in the joint itself, and motion in the joint is affected slightly if at all. Muscular spasm and atrophy are absent, and the tumour is more sharply circumscribed, and is in the diaphysis rather than in the epiphysis. The x-ray findings may be negative, but if they be positive they will show a distinct growth on the bone or an excavation of it, and not an irregular erosion or rarefaction.

Fracture in the neighbourhood of a joint. The symptoms follow an injury immediately, or rarely are separated from it by a very short interval. Frequently the classical symptoms of fracture may be elicited. Atrophy and true muscular spasm are absent. Many a fracture of the neck of the femur, or separation of the epiphysis, in children has

¹ Goldthwait, Painter, and Osgood. Diseases of the Bones and Joints, 1909.

been treated at length for tuberculosis, to be later discovered by the *x*-ray. A careful use of the tape in this form of fracture reveals a slight shortening, but a skiagram is the best means of diagnosis.

Sprain.—Under this head are included various ill-defined lesions, especially of the hip, knee, and back, which often can be correctly diagnosed from tuberculosis only by several examinations at different times, and by watching carefully their course. Their tendency is



FIG. 28.—Sarcoma of femur; operated on for tuberculosis.

toward recovery in a comparatively short period. "Sprains" of the hip are sometimes accompanied by spasm and by limitation of motion, but not by muscular atrophy. Spasm and limitation of motion are also found in "sprained" backs; pain, swelling, and joint effusion in "sprains" of the knee. The *x*-ray findings are invariably negative. Many a so-called brilliant cure of joint tuberculosis is doubtless nothing more than a cured sprain. The well known sprain of the ankle is easily distinguished from tuberculosis.

Hæmarthrosis.—This condition, though rare, is most important to remember. A mistake may be disastrous. One knee in our collection was resected with a diagnosis of tuberculosis. The patient died

in a few days. His history said that in childhood he had had "rheumatism" in both elbows and in his left shoulder. One year before admission the left knee began to swell, but it had never been painful nor did it keep the patient from work. "At one time it was like a balloon." The knee was swollen and full of fluid. No crepitus, muscular spasm, nor atrophy was present. The circumference of the joint showed an increase of 4 inches.



FIG. 29.—Sarcoma of femur. Antero-posterior view of case shown in Fig. 28.

The significant points are the absence of pain, atrophy and spasm, the large amount of fluid, and the possible history of prolonged hæmorrhage after insignificant injuries.

Sometimes after the absorption of the fluid, the patient will present himself for treatment on account of the dense fibrous adhesions in the joint. Under no circumstances should any mobilising measures be taken. A skiagram of such a case is appended. The elbows and one knee were affected. The diagnosis was made on the distinct history. There was practically no motion in the joint, no swelling, nor any symptoms of active disease.

Hysterical or Neurotic Joint.—The main point in the diagnosis of joint neurosis is the total disproportion between the subjective and the objective symptoms. The patient will complain of great pain, may manifest exquisite sensitiveness to manipulation, and may exhibit various deformities, yet not by inspection, palpation, nor by the use of the tape can any definite anatomical change be detected. A sort of false, voluntary muscular contraction may be present, simulating

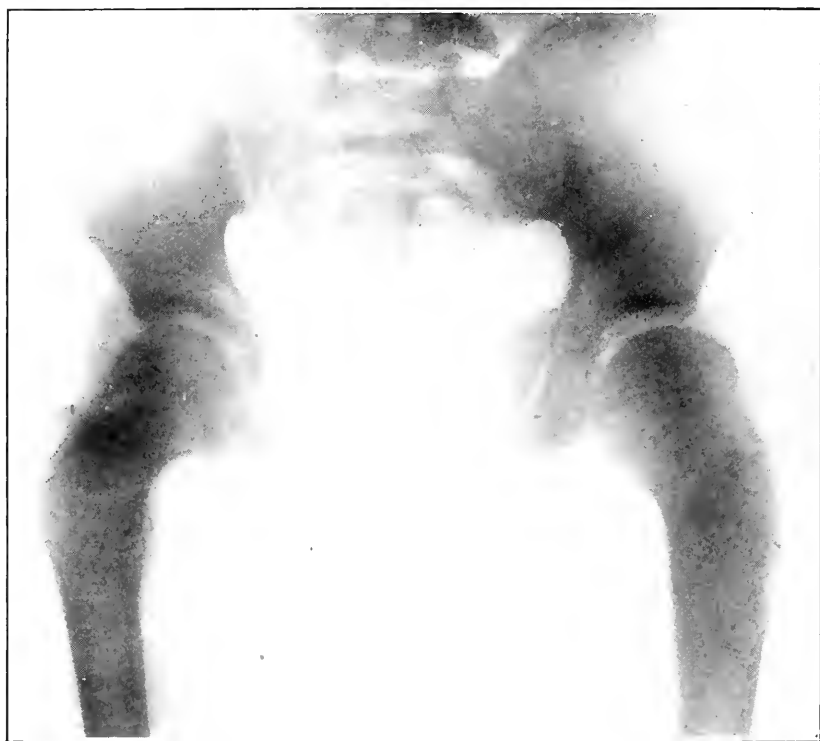


FIG. 30.—Epiphyseal separation. This case had been treated for months as hip-joint disease. The affected joint is on the right of the picture.

muscular spasm, but this will disappear if the patient's attention be diverted, and any existing deformities will usually fail to correspond with the symptoms of which the patient complains. A careful search will reveal hysterical stigmata, but too much weight must not be attached to these, for it is perfectly possible for an hysterical patient to have a tuberculous joint. To treat a joint neurosis as tuberculosis is an error of judgment from which no real harm will accrue to the patient, but to treat a tuberculous joint as hysteria is a serious blunder

that may inflict great pain and damage. Hence one should make it an invariable rule never to make a diagnosis of joint neurosis until repeated examinations have failed to reveal the presence of any local pathological condition. In addition, it may be said that the patient will rarely forgive the surgeon who makes this diagnosis, whether it be correct or incorrect.

A form of *chronic arthritis* has been described as occurring in caisson workers. It resembles in its manifestations other forms of chronic arthritis, but its diagnosis and its pathology have not been thoroughly established.



FIG. 31.—Old hamarthrosis of knee.

Finally, if one is in doubt, one should demand more time and further examination, or perhaps a consultation. One should never say, "There is nothing the matter" with a child that limps or suffers pain. A limping child does not "outgrow" his limp, and parents do not bring children with "growing pains" to see their medical adviser. Night cries are not to be dismissed lightly as "worms," and "nervousness" does not impel a child to complain of pain in his back, abdomen, or extremities. The appearance of a tuberculous abscess in a patient who has been treated at length for "rheumatism" has furnished many a rude shock. Sprains, and joint inflammations never "run into" tuberculosis. A tuberculous joint is tuberculous from the start.

CHAPTER VI.

PROGNOSIS.

The prognosis in tuberculous joint disease varies with the age of the patient, the joint affected, the severity of the infection, the resisting powers of the patient, and with his hygienic surroundings. In general, under favourable conditions it may be said to be good. The smaller the joint, as a rule, the better the prognosis as to function.

The presence of an abscess makes the prognosis more unfavourable, but tuberculous joints healed after abscess formation are probably less liable to relapse than others. A large abscess in spinal caries is always a grave complication, but, if kept from rupturing, it may not materially influence the outcome. An infected spinal abscess often is the patient's death warrant. Sooner or later he may succumb to general tuberculosis, meningitis, pulmonary involvement, sepsis, or to amyloid degeneration of his viscera.

In children a better functional result may be expected than in adults. In adults a perfectly stiff joint is all that we can get, possibly with rare exceptions.

We must not lose sight of the disease we are treating. At any time the joint lesion is liable to be complicated by a tuberculosis of some other organ, which dominates the case, and carries off the patient.

Deformity.—Sometimes a tuberculous joint recovers without deformity, but as a rule the absence of all thickening, induration, or other sign of previous involvement in a joint is proof that it has never been the seat of tuberculosis. Some evidence of disease almost invariably persists.

The resulting deformity depends largely upon the time when treatment is instituted, and upon the efficacy of the means adopted, and varies according to the location of the disease. In disease of the joints of the extremities the limb on the affected side is usually shorter and smaller than its fellow. Under favourable conditions the joint should recover in a position good functionally and cosmetically. Abscesses leave depressed scars behind, but nothing else.

The prognosis in sacro-iliac disease is distinctly bad, especially with a ruptured abscess.

The length of time required for a cure under conservative treatment varies again as the size of the joint. One year may be said to be the minimum for the smaller joints, and three to five years for the hip and spine. From these figures we can run up to a maximum of ten years or even longer.

One of the greatest difficulties of the surgeon is to secure the co-operation of the patient or of his parents, and to hold it through the long course of the disease. It is well to explain, in the first place, about what may be expected—length of treatment, complications, etc.—and to emphasise the importance of perseverance, obedience, and faithfulness. By operation we can often cure the disease in a short time, as will appear in the section on treatment.

Later Prognosis.—The ultimate prognosis is rather unfavourable. Many patients recover from joint tuberculosis to die later from tuberculosis of the lungs or of some other organ. This may be due to a transmission of the infection from the original focus, or it may be that the conditions and surroundings which produced the first infection, continuing to act, cause the disease in other organs of the body. The predisposition to tuberculosis, the "tuberculous habit," upon which so much stress was formerly laid, probably plays not so much of a rôle as the infected surroundings in which the patient lives, possibly the unsanitary house in which lurk millions of tubercle bacilli.

Whether, when patients suffering with tuberculous joints are removed from their surroundings and are placed under favourable conditions, they will continue to exhibit a marked predisposition to the disease, is a problem whose solution has not yet been fully worked out. It is by no means a simple one. We are all exposed to infection. Not always those most exposed succumb earliest.

Some races seem to have acquired more or less of an immunity; some are especially liable, notably those who have been accustomed to living in the open air and then have been transplanted to cities and live indoors. Tuberculosis is a disease especially of civilised human beings, and in the end will probably die out when the race has acquired an immunity to it. In the meantime the physically unfit will be weeded out. One might question, then, the wisdom of trying to eradicate tuberculosis or to cure those afflicted with it. The physically fit are not always the mentally fit, and minds most useful to the race are not always in the most rugged bodies. Only among savages is the law of the survival of the physically fittest permitted to work unmodified.

Fortunately, the medical profession is not compelled to enter into academic discussion. Its sole duty is to cure disease and to preserve health.

CHAPTER VII.

TREATMENT.

The treatment of tuberculosis of the bones and joints may be divided into 1, general, and 2, local; and the latter may again be divided into conservative and radical.

1. General Treatment.

This includes diet, fresh air, exercise and everything tending to improve the patient's nutrition. The bone lesion is to be regarded as a local manifestation of a constitutional disease, *and the treatment of it is influenced by this fact*. The patient must be kept under the best possible hygienic conditions. He must have fresh air all the time, good food, and careful attention to his digestion and other functions. The first requirement is that he be kept out of doors all day, and sleep with his windows wide open at night.

The wards of a city hospital are no place for cases of joint tuberculosis, and they do ill there. This has long been recognised. In theory the need of fresh air has also been recognised for some time, but in practice it is often neglected. The local treatment is always to be carried out with an eye to this fact, and long confinements in bed, except with very young children, are to be avoided when possible.

In former days, when the idea of rest first obtained, patients were put to bed and were kept there for long periods, but it was found, that although their local lesion improved for a while, they soon suffered in general health. The whole treatment of these cases is more or less of a compromise. We wish not only to cure the bone or joint lesion, but also to cure the patient of his tuberculosis. A stiff joint in a healthy body is much to be preferred to a movable one in a tuberculous patient. Any treatment, no matter how attractive, is to be rejected if it keeps the patient long indoors.

Pain is to be combated by complete rest. It is often a sign that the treatment is not effectual and it should not be quieted by morphine, except under unusual circumstances. Severe pain sometimes accompanies the formation of an abscess and continues as long as the contents are under pressure.

Drugs are of little use in this disease. One should avoid them where possible. Cod-liver oil may be exhibited, but the need for it will usually disappear if the patient, kept in the open air, have a good appetite and receive good food and plenty of it.

Fever.—High temperature is usually the result of secondary infection, and the treatment should be the treatment of the infection. Patients treated indoors often will have a moderate amount of fever, which will disappear if they are kept in the open air. Occasionally a patient who has been for a long time in recumbency will be seized by a high fever and alarming constitutional symptoms, for which no cause can be found other than intestinal intoxication. The fever will disappear completely if the intestines be cleaned out, a support be applied, and the patient be allowed to go about. In one case at Sea Breeze a boy who had been on a frame for a long time was taken sick in this way, and was thought to have meningitis. His colon was irrigated daily, and as soon as possible a jacket was applied, and the symptoms rapidly cleared up.

Constipation.—This is apt to be a troublesome condition in patients who are treated long in recumbency. The diet should be chosen with regard to its laxative qualities, but sometimes enemata or mild cathartics will be necessary. Occasionally we are forced to abandon recumbency and to get the patient up, wearing apparatus. Here again we compromise.

Loss of Appetite.—In the ordinary case, treated in the open air, the appetite will not require any stimulation. It is far better to rely on fresh air than on tonics and appetisers, and much more efficacious.

2. Local Treatment.

This may be divided into conservative and radical, and the indications for each vary generally as the age of the patient, the joint involved, and much less as the severity of the infection. In the spine the main treatment is always conservative. Upon this point, opinion is practically unanimous, and here unanimity may be said abruptly to end. We can fix the joints of the spine and we can do little else with them. We can neither pull them apart nor make any reasonable attempt at eradicating disease from them. Hence the harmony is a forced one.

In the treatment of other joints every man is a law unto himself. In a general way we all recognise the beneficial results of rest in tuberculous joint disease. Some of us unwittingly follow it as a curative principle because empirically we have observed its curative effects,

but most of us lose sight of the real principle and fasten our attention upon a corollary—"traction," "fixation," and the like. Some believe in operating always, others operate almost never. Some operate early, some late. Some scrape, drain, and pack, others view the curette with aversion. Some amputate as soon as they are "reasonably" sure of the diagnosis. Some dread secondary infection, others regard it not at all.

Now, this is not so in other diseases. In dealing with them there

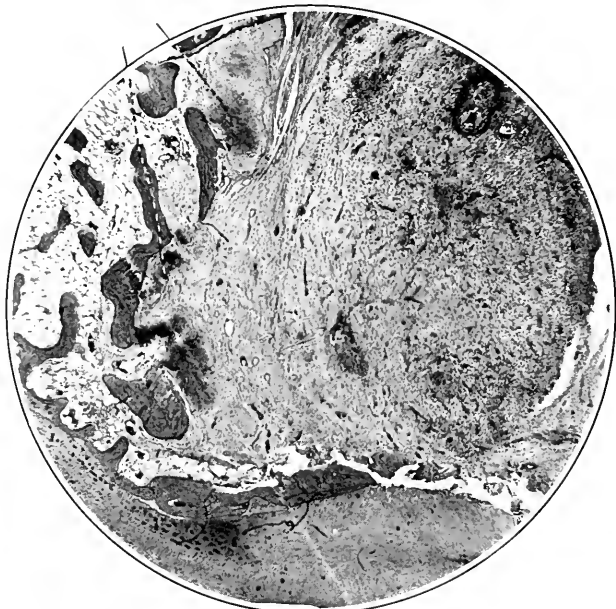


FIG. 32.—Old encapsulated tubercle in bone. It lay directly under cartilage. Its site could be told from the joint side by a dimple in the cartilage. Note the fibrous capsule, and outside of this the strengthening of the bone trabeculae. The dotted lines lead to two small islands of cartilage. Although we possess no history of the resected adult knee from which this specimen was taken, it is evidently a case of lighting up of an old process.

is a weight of scientific opinion that one will always do well to follow. Here there is no weight of scientific opinion. He who practises conservative treatment looks with contempt on him who operates, and *vice versa*. This is why I say that the treatment of joint tuberculosis is purely empirical, and that ignorance is at the bottom of the difference of opinion. When we understand a disease, we cease to differ on it. Until then, each of us rests his treatment upon his experience, or upon the experience of others, and changes his views from time to time.

There are certain facts that all must recognise:

1. After a typical resection of a child's joint, the cessation of growth at that epiphysis, and, by consequence, as the child grows up, the lagging behind in growth of the resected limb.
2. The favourable effect of rest upon joint tuberculosis.
3. The liability of patients with joint tuberculosis to suffer with tuberculosis elsewhere.



FIG. 33.—Old encapsulated cheesy tubercle, from ankle-joint of a boy about 18 years old. The joint had been treated conservatively for a number of years, and was supposed to be well. A resection was done because the joint had again become painful. The ankle was found full of fibrous adhesions, and in a recess of the joint this tubercle was discovered after a prolonged search. The hospital laboratory had reported "chronic arthritis, no tuberculosis."

4. The tendency of a prolonged mixed infection to be followed by amyloid degeneration and involvement of the viscera. These facts may be taken as granted—as a common standpoint.

The opinion is practically universally accepted among those who practise conservative treatment in the tuberculous joints of children that these joints can usually be cured in this way, often with good function, and that the results of conservative treatment are better than those of radical. To one who weighs the evidence carefully this contention appears justified.

On the other hand, those whose practice brings them into contact with adult patients, and who exercise care and skill in their diagnosis, assert that conservative treatment is always tedious, and almost always unsatisfactory, and that the results after radical treatment are usually better than after conservative. A careful study of tuberculous joints in the laboratory and of the histories of the patients from whom they were removed teaches us that this assertion is correct. My own clinical experience also leads me in the same direction. While there is something in the resisting power of the tissues of children that permits recovery of their joints under favourable circumstances, cure of adult tuberculous joints, except, possibly, those of the milder synovial forms, seldom if ever occurs under conservative treatment. Even in those joints supposedly cured thus, there lurks a focus of disease ready at any time to light up afresh. Function is almost always badly damaged and often painful. On the other hand, if an operation planned on correct lines be carried out, tuberculosis cannot exist longer in that locality.

Although we may not hope for unanimous concurrence, we may safely rely, from what has been said, on having strong authority behind us when we lay down this main rule:

The treatment of joint tuberculosis in children is almost invariably conservative, in adults it is almost invariably radical. In adolescents it is conservative. If the disease be not cured when they have reached their growth or nearly reached it, then the treatment should be radical.¹

The chief exception to the rule of conservative treatment in children is that in some severe cases with marked constitutional involvement we must operate to save life. Then we usually amputate. Again, if a sequestrum be present in the face of a secondary infection it had best be removed, but with as little damage as possible to the surrounding tissues.

The chief exception to the rule for adult joint disease is as follows: Bearing in mind the fallibility of our diagnosis and the statements of some authorities that occasionally the milder synovial forms recover in a comparatively short time with good function, it is always well to recommend a six months' trial of conservative treatment. If then a

¹ "D'une façon générale, on persévère dans le traitement conservateur d'autant plus longtemps que le sujet est plus jeune, car il n'est pas douteux que, toutes choses égales d'ailleurs, la même affection tuberculeuse guérit beaucoup plus rapidement chez l'enfant que chez l'adulte. Chez un homme ayant dépassé la cinquantaine, il ne faut plus s'attendre à voir guérir sans opération, même une affection aux apparences légères (Koenig). De plus, il faut toujours se souvenir que, chez les enfants, la résection présente l'inconvénient majeur d'arrêter la croissance du membre opéré au point que souvent, au bout de quelques années, le malade ne peut plus s'en servir.

"En somme, lorsque après un an on d'avantage, sous l'influence du traitement conservateur, les accidents ne se sont pas amendés ou se sont même aggravés, alors, même qu'il n'y aurait ni fistules ni abcès apparents, on peut considérer l'affection comme grave et intervenir. Dans ces cas, il s'agit le plus souvent de lésions osseuses et de désordres articulaires étendus." Lagrange: *Traité de Chirurgie*, 1901.

marked improvement be not apparent, and if we still hold to our diagnosis of tuberculosis, we resort to operation.

Conservative Treatment.

The terms "conservative" and "mechanical" are used more or less synonymously, but though conservative measures are in the main mechanical, they include also certain small operations that may be done from time to time to meet special indications, and also certain forms of treatment that are devised to supplement mechanical treatment or to supplant it.

Mechanical Treatment.

Three general means of carrying out mechanical treatment are at our disposal: 1. Recumbency, with or without extension. 2. Plaster-of-Paris dressings, or dressings made of similar substances. 3. Braces made of steel, leather, celluloid, etc. The special indications governing the application of these means in disease of the various joints, and their description, will be taken up in the appropriate chapters, but the underlying principles may be discussed here.

Let it be said in the first place that in none of them is there anything mysterious. No one of them in itself or by itself works a cure. No matter what the idea of its inventor may have been, no matter how much stress he may have laid upon the importance of some theory more or less correct, no matter whether the apparatus be easy of application or difficult, complicated or simple, expensive or cheap, it owes whatever efficacy it possesses primarily to the amount of rest and protection it affords. If any form of apparatus be very expensive or complicated, very difficult to construct, or very heavy, it will never attain wide use, and it must be generally discarded in favour of some other, but in favour of some other that will afford rest and protection to the joint.

Sometimes these facts, which should be self-evident, are forgotten, and the extravagant claims of some brace-maker will obtain wide acceptance. In discussing a paper of Lorenz's, Biloeth summed up the situation with wonderful acumen. He said, in speaking of the Helsing brace, which has obtained in Germany a wide repute: "These things cost a horrible amount of money (ein horrendes Geld) which people give up willingly who have none for a brace prescribed by a doctor, and for the doctor himself absolutely none." "People recognise two kinds of knowledge, the one that a man can learn, which impresses

them not at all, and the one that falls from heaven and is bestowed on the huckster or on the smith. This last impresses them strongly."

In a general way two theories may be said to exist as to the manner in which this rest and protection should be applied, and on these two theories two schools have grown up, one believing in traction and the other in fixation. In point of fact, when we examine into them we find that there is nothing essentially different in the principle upon which both fixation and traction depend.¹ Each is simply efficient according as it provides rest for the joint, and in no other way. After we have mastered the pathology we are in a position to understand this.

Traction has been praised because it "pulled apart the inflamed joint surfaces"; but the *joint surfaces* are not inflamed at all. Composed of cartilage they are not capable of inflammation until the cartilages have disappeared. The seat of fibrous change, bereft of their homogeneous physiological structure, with their nutrition often impaired by the involvement of the bone beneath them, the cartilages are not fitted for their natural function, namely motion, and possibly might wear away if motion were persisted in, but as to the cartilages themselves being inflamed, we have seen that this is not so.

Of the only two tissues that are ever directly involved, the synovia and the bone marrow, the synovia cannot be affected at all by pressure or weight bearing, and the bone marrow (if the cartilage be still present) cannot be affected directly by motion or possibly by pressure. For our comprehension of the working of any and all conservative treatment we must recognise the fact that function means an increase of the peculiar elements of the only two tissues in the joint liable to tuberculosis, *i.e.*, the red marrow and the synovia, and that the function of a joint is motion. The more completely the joint is deprived of function the less of these elements there will be.

After complete bony ankylosis in an adult, tuberculosis cannot exist in that locality, because neither of these elements is present. All conservative treatment as well as all operative treatment depends on this principle. Even in Pott's disease the recumbent posture does not work primarily in taking the weight off the diseased bone but in putting the spine at rest, and so by checking the tuberculous inflammation that is eating away the nutrition of the bone trabeculae, softening them and breaking them down.

Recumbency.

This is the ideal method of obtaining rest in tuberculous joint disease, but, except in very young children, it is impracticable for long

¹ It must be remembered also that traction is applicable to only two joints in the body—the hip and the knee.

periods as a routine treatment. Its main indications are great pain, high temperature, large abscesses, psoas contraction, or deformities of any sort which are to be slowly reduced by traction. The patient may simply be put to bed with whatever dressing or appliance he may have on the diseased part, or he may be strapped to a frame or padded board, or put into a plaster-of-Paris bed, or into a so-called *ceirasse*.

If extension is to be applied in the hip or in the knee it must always be in the line of the deformity, and, as this yields, the extension is made more and more in the normal attitude of the limb. A board, on which plays a pulley, should be fastened to the foot of the bed, and over this pulley a rope, with weights attached, plays. From 5 to 20 pounds or more of weight may be used, and the foot of the bed is raised to provide counter-extension. It must be raised enough to keep the child from sliding down in his bed, for when his foot touches the bottom, the extension ceases to act. A child with weight and pulley extension must be carefully watched, for he will devise all sorts of ingenious ways to ease himself of the pull.

Recumbency is an excellent means of treatment for the early stages of tuberculosis of the hip or of the spine, as a matter of routine.

Plaster of Paris.

Of all the materials that have been used for the construction of splints, plaster of Paris holds first place. It enjoys an ever increasing popularity, and those who are most proficient in its use are its most enthusiastic advocates. Its disadvantages are that it shuts the part up completely and prevents its frequent inspection (not necessarily a great objection), it is liable to cause pressure sores unless accurately padded, and it may cause constriction if put on too tightly, it is easily destroyed if soaked by the patient's discharges, and it is impracticable where many sinuses are present. Of all these disadvantages the last is the most serious. On the other hand, plaster of Paris is very cheap, it fits more accurately than any brace, and holds the part more firmly, it dispenses with the aid of a brace-maker, it does not require constant supervision and cannot be removed at home by the patient or by his parents, it is quickly made, and, as a rule, is less unsightly than a brace.

Certain rules must be observed in the use of plaster in order to be successful with it: 1. All bony prominences must be well padded. 2. The bandages must be applied smoothly, accurately, but not too tightly. 3. The dressing must extend well above and below the seat of disease in order to obtain proper leverage, and must be well molded

over the part. 4. The plaster must be thick enough to stand the strain to which it will be exposed, but not one bit thicker.

Plaster bandages are best made of some brand of crinoline, starched, but free from glue or dextrine, torn into strips 4 to 6 yards long and 3 to 6 inches wide. Into the meshes of this, fine dental plaster of Paris is rubbed by hand, and then, by hand, the bandages are rolled very loosely, leaving a hole in the centre of the roll, so that water may easily reach all parts of the bandage.

The part to be bandaged is first covered with snugly fitting shirt-ing. Next, the bony prominences are well padded with felt, sheet wadding, or cotton batting, which may be held in place by a bandage of gauze, muslin, or cotton flannel. Then a plaster bandage is stood on end in a pail of warm water and is left there until the bubbles cease to rise. No salt nor any other substance to hasten setting is necessary if the materials are of proper quality.

Before the first bandage is removed from the water another is set in, and then the first one is wrung out lightly, and smoothly applied to the part. The other bandages follow in quick succession, until the dressing is completed. As each one is applied, it is rubbed well with the hands so that the whole is a homogeneous mass, and all are molded well on the part. Finally, any superfluous portions of the plaster are trimmed off above and below with a sharp knife.

Good plaster will harden enough for practical purposes in fifteen minutes, though it will not be thoroughly dry for a day or two, and, if kept clean and dry and not exposed to blows or to pressure by hard substances, it will last from a month to a year.

If a strip of muslin or of linen be run longitudinally under the shirting before the dressing is applied, the patient's skin can be kept in good condition during the entire time that the splint is in place. This is the so-called "scratch bandage," which is daily pulled up and down over the surface of the skin, and whose efficacy is increased by a liberal use of dusting powder.

Thin strips of wood, steel, or tin may be incorporated in the plaster dressing to strengthen it at the points of strain, or, better yet, this result may be obtained by frequent reverses of the bandage at these points to make the plaster thick and strong. In applying a dressing to a flexed joint, it is well to run the bandage up and down a number of times over the extensor surface in order to avoid piling up the plaster in the re-entrant angle, where it is not needed.

If any sinuses are present in a part that has been bandaged, windows may be cut in the plaster at their site. A foul odour under the plaster indicates a pressure sore or a ruptured abscess, and necessitates

the immediate removal of the dressing. If it be desired for any reason to have the plaster dressing removable, it may be slit up before it hardens, sprung off, and provided with lacings, or with straps and buckles.

Other materials have been proposed as substitutes for plaster-of-Paris, such as silicate of soda—water glass—but they have not attained wide use.

Braces.

These are best taken up under the special chapters on the diseases of the various joints, but a few remarks on their use may be made here. As a general rule, no brace (or for that matter no plaster bandage) should be relied upon to correct a deformity occurring in tuberculous bones or joints. This should first be corrected, either rapidly under ether or slowly by traction, and then the appliance should be used to hold the parts in place. Braces are devices for preventing deformity, not for correcting it.

A patient should never be sent to a brace-maker with the instructions to have a brace made. The brace-maker should be told exactly what to do, and the surgeon must see that his instructions are carried out. An ill-fitting brace, or one not adapted to the purpose for which it is intended, is worse than useless. The brace-maker is not a physician, but a mechanic, and his business is to make and to sell braces. If the physician is unable to oversee the construction and application of a brace, or unwilling to do so, he should not undertake the work. Plaster dressings are much preferable under these circumstances.

To measure for a brace is an operation that needs a little practice. A simpler and more exact method is to make a cast¹ of the part, and let the brace-maker construct his brace over this. The part is first lightly padded, and then over this a thin plaster dressing is applied, and afterward is slit up and sprung off. If this be filled with fluid plaster cream, perhaps mixed with shavings, cotton, or oakum, we shall have an exact cast of the part.

A skilled instrument-maker is a convenience, but not a necessity. If the surgeon knows exactly what he wants, a blacksmith and a harness-maker can carry out his instructions.

A brace should fit snugly and should hold the part firmly, but not too tightly, and should not cause pain. In using a brace for a child

¹ In order to avoid misunderstanding, it is well to distinguish between a plaster cast and a plaster dressing or bandage, terms often and incorrectly regarded as synonymous. A plaster cast is a counterfeit presentment of a part, while a plaster bandage, splint, or dressing is, as the name implies, something that is put on over the part.

we must never forget that if it be possible for him to do so he will almost invariably loosen it or take it off. It often comes as a shock for the surgeon who has carefully adjusted his apparatus to see his patient afterward in the street.

Treatment by Tuberculin, Vaccines, etc.

This treatment, from which so much was expected, has not justified the hopes that were reposed in it. Isolated reports have been made of successful results, but the best judgment seems to be against it.

The use of vaccines and of tuberculin in tuberculous joints was ably discussed at the Congress of American Physicians and Surgeons in 1910 by Painter¹ and by Ridlon² and their conclusions were received with marked unanimity. Painter summed up as follows: "As regards gonorrhœal and tuberculous joint infections, there does not seem as yet to be any well-established theoretical ground for a belief that vaccination after infection could play a curative role. Practically there is very little evidence that it ever has." Ridlon said: "Tuberculin administered by the clinical method in harmless doses is useless; administered in larger doses it is both dangerous and harmful."

The final word has not yet been spoken in this matter, and the future may cause us to reverse our conclusions, but for the present we may say that tuberculin and vaccines have not proved their usefulness. He who treats an occasional case of tuberculous joint disease will do well not to lose time experimenting with them. Much the same may be said of Marmorek's serum.

The Bier Treatment, Passive Congestion, Stauungshyperæmie.

In 1892 Bier³ first promulgated his idea of treating joint tuberculosis by the induction of a passive hyperæmia in the affected limb, and since that time he has again and again called attention to the subject. He has been joined by many others, and the bibliography on this method of treatment has reached remarkable proportions. For us to go deeply into all the aspects of "Stauung" would require too much space, but so important has the treatment become that we can profitably devote some time to a short sketch of it.

First, we must criticise the soundness of Bier's fundamental argument. It is based upon Rokitansky's observation that patients with

¹Painter. Vaccine Therapy in the Management of Arthritis. Transactions of the American Congress of Physicians and Surgeons, vol. viii.

²Ridlon. Value of Tuberculin in Tuberculous Joint Disease. Transactions of the American Congress of Physicians and Surgeons, vol. viii.

³Bier. Verhandlungen der deutschen Gesellsch. f. Chir. 1892, i, S. 91.

mitral lesions that cause pulmonary stasis, rarely have pulmonary tuberculosis. Now, this pulmonary hyperemia is essentially an arterial one, and Bier distinctly discountenances arterial hyperemia in the treatment of tuberculous joints. Again, mitral lesions are usually rheumatic in origin, and it seems to be more or less a well recognised clinical fact that persons with the "rheumatic diathesis" rarely have tuberculosis. In other words, there is a certain antagonism between "rheumatism" and tuberculosis.¹ On the other hand, I can recall a case of Pott's disease, that ran a severe course of four years at the Sea Breeze Hospital, and in the end turned out most unfavourably. The patient had a poorly compensated mitral lesion, and his feet and hands were usually bluish red from venous congestion.

However, a treatment may be efficacious although the arguments adduced to support it may be quite fallacious. Many observers have vouched for Bier's hyperemia, and I think I have seen good results from its use.

In tuberculous joints the hyperemia is produced in one of two ways, *i.e.*, by the elastic ligature—venous hyperemia, "Stauungshyperemie"—or by the cupping glasses, or vacuum glasses—"mixed" hyperemia.

The elastic ligature should be applied from one to three hours daily, and the portion of the limb below the ligature is left unbandaged. If the skin be at all sensitive, it should be covered by gauze before the bandage is applied. The ligature is the ordinary Esmarch bandage, 6 cm. wide, with its layers more or less spread out so as not to exert undue pressure on any one spot. It should be applied just tight enough to make the part distal to it bluish red and warm.

Bier emphasises the importance of a warm and a painless hyperemia, and treats all his tuberculous joints in this way, whether they be "open" or "closed." If sinuses be present he uses cups in addition. When abscesses form he recommends that they be opened by a small cut and that they be cupped. Meanwhile the elastic ligature should be continued.

Bier regards an abscess, not as a contraindication to the treatment, but as an incident in the process of healing, as nature's effort to throw off the disease. No fixation apparatus is necessary, except, perhaps, in disease of the foot or knee. The treatment must be carried on for at least nine months. It is not well adapted to the knee.

Mixed Hyperæmia, by cupping. This modification of Bier's original ideas has been devised by Klapp, his assistant. He uses glass cups,

¹"Il semble plutôt y avoir un certain antagonisme entre les arthritides rhumatismales et les lésions fongueuses des jointures." (Lagrange: *Traité de Chirurgie*, 1901.)

of various sizes and shapes, to fit the different parts of the body. To these are attached rubber bulbs to exhaust the air. The cups, sterilised before using, are applied over the mouths of the tuberculous sinuses, are left in place for about five minutes, are removed for about three minutes, and are then applied for about five minutes in a slightly different place in order to avoid pressure irritation. This procedure is continued for about three-quarters of an hour, at first daily, then every two or three days. The area to be cupped should first be washed with benzine and should then be covered with equal parts of vaseline and lanolin, on account of the liability of the unprotected skin to tuberculous ulceration.

Klapp uses these cups, not only for infected abscesses and sinuses, but also for the uninfected abscesses. These he opens by small incisions, and maintains that his suction prevents their subsequent infection. This may be so, for Hofmann¹ found under the microscope that cupping produced a widening of the walls of the vessels in granulation tissue and a profuse washing out of leucocytes, and Félégházi² that great numbers of bacteria were drained out. Others have pointed out that the good results of cupping were due not only to hyperæmia, but also to mechanical suction, and this seems reasonable.

To induce a suction hyperæmia in a limb, glass chambers of various shapes and sizes have been recommended—"Saugapparate"—connected to a suction pump by a rubber tube, and provided at their open extremity with a loose, soft-rubber cuff. Into the apparatus the limb is placed, and the chamber is made air tight by applying two or three turns of an Esmarch bandage over the cuff. Hence the resulting hyperæmia is one not only by suction but also by passive congestion from the rubber bandage. The air in the chamber is partially exhausted, and the limb is left in the partial vacuum for a few minutes. Then the air is readmitted. After a minute or two the procedure is repeated, and so on for about twenty minutes to a half hour. The treatment at first is given daily, later on every two days. It is said to be very beneficial in spina ventosa. Here the entire hand is inserted.

Various views have been advanced as to the rationale of the treatment, some of which may be found in the bibliography below.³ Webb,

¹ Hofmann, Münch. med. Woch., 1905, No. 39.

² Félégházi, Deutsche Zeit. f. Chir., xciii, S. 459.

³ Bier, Cent. f. Chir., 1894, No. 30.

Bier, Esmarch Festschrift, 1893.

Bier, Verhandlungen der deutsch. Gesellsch. f. Chir., 1894, S. 94.

Bier, Hyperæmie als Heilmittel, Leipzig, F. C. W. Vogel, 1907.

Klapp, Zeitschr. f. ärzt. Fortbildung, 1906, ix, 281.

Klapp, Arch. f. klin. Chir., 1906, lxxx, 42.

Köng, Tuberkulose der mensch. Gelenke, Hirschwald, Berlin, 1906.

K. Vogel, Deutsche Zeit. f. Chir., 1908, xcvii, S. 109.

Deutschländer, Münch. med. Wochenschr., 1907, S. 721.

Bum, Wiener med. Presse, 1905, Nos. 3 and 4.

of Colorado Springs, has recently brought out the significant fact that the proportion of lymphocytes is increased by passive congestion.

We find that Bier's hyperemia is impracticable in disease of the spine and of the hip and more or less so in disease of the shoulder. Most observers affirm that its field of usefulness in the knee is limited. *In children* we must compare it with immobilisation in disease of the ankle and tarsus, the elbow, wrist, and fingers. In all but the last it is probably inferior to mechanical treatment, if no infected sinuses be present. In the presence of infected sinuses it is well worth a trial.

In adults treatment by immobilisation has rather a gloomy outlook, and therefore, if the patient be willing to devote the time to it, we are justified in using hyperemia in the joints above enumerated; but here also the statement must be modified. In early cases of disease of the carpus and tarsus we might be able, as will appear hereafter, to eradicate the entire disease by a small operation, whereas, if we wait too long, a much more extensive operation may be necessary. In other words, we have something to gain and something to lose, and in every case we must weigh carefully the arguments pro and con. My own experience with the treatment would cause me to decide against its use in the so-called closed cases (those without sinuses), but in infected cases to give it a trial before resorting to a resection. I believe the Bier-Klapp method of treating abscesses inferior to that by aspiration and injection.

Treatment by Injections.

This has obtained a much greater vogue abroad than it has in America. The idea underlying it is that we shall cure the disease by the local effects of some mixture, usually iodoform,¹ injected directly into the joint and into the circumarticular structures. This mixture is

Hofmann. Munch med. Wochensh., 1905, No. 39, S. 1864.

Henle. Beiträge zur klin. Chir., 1898, xx, 3, S. 803.

Gebele and Ebermayer. Munch. med. Woch., 1906, No. 13.

E. v. Féléghazi. Deutsch. Zeit. f. Chir., xciii, S. 459.

V. Schmieden. Medical Record, lxxii, No. 7.

W. Kühne. Monatsschr. f. Unfallh., xiv, S. 104.

Krause. Deut. Chir., Lief. 28 a., S. 221.

Habs. Munch. med. Woch., 1903, No. 22, S. 938.

Chaput. Revue de Chir., xxxix, 1909, p. 1229.

Dupont. Revue de Chir., xxxix, 1909.

Debrez. Arch. provinciales de Chir., 1909, No. 1.

Gebele. Münch. med. Woch., 1908, Nos. 3 and 4.

Bennett. British Med. Journal, Nov. 21, 1909.

Waterhouse. British Med. Journal, July 18, 1908.

Geekoff. Russian Archives of Surgery, vi, 1908.

Assny. Archiv. f. klin. Chir., lxxxviii, 1908-9.

Panzaecchi. Atti del Congresso della Soc. Ortoped. Ital., 1907.

Meyer. Annals of Surgery, 1906, xxxviii, 106.

Mikulicz. Central. f. Chir., 1894, No. 12.

Ely. Surgery, Gynecology and Obstetrics, January, 1910.

¹ Iodoform and glycerin, iodoform and olive oil, or iodoform and ether. Formalin also has its advocates.

supposed to exert a specific curative effect upon the tuberculous process.

Now, if we can convince ourselves that the fluid in the synovial sac is responsible for the entire disease, we shall be quite ready to admit that to draw it off and to replace it with some specific curative substance (provided such a substance can be found) is to make a long stride toward cure: But if we regard the exudate as a mere symptom, we immediately become sceptical, and view any and all good results from injections as due to some other than a bactericidal or specific cause. Again, there are many cases in which no fluid can be demonstrated in the joint. What of these? How can an injection affect a joint full of fibrous adhesions, and perhaps divided into numerous pockets or compartments? It is not likely that any substance thrown into a joint can make its way deep into the synovia and into the other soft tissues, where the tubercles are known to lie, while to hope that we can influence directly a disease located in the bone by injecting some substance into the joint cavity is even more futile. If one may indulge in the comparison, it is like attempting to fill up with cobblestones the meshes of a sponge immersed in a pail of water, by placing them in the pail.

Again, blindly to inject any substance into a mass of tuberculous granulations about the joint, with the thought that it will so diffuse itself through these granulations as to exert a specific curative effect upon them, appears absurd.

The only rational explanation of the many cures that reliable observers have claimed for these injections is that they work mechanically, by setting up an irritation in and about the joint, and so hastening the efforts of nature and re-inforcing them by promoting the formation of fibrous tissue and by depriving the joint of function.

These may be said to be the principal methods of conservative treatment, but they exhaust by no means the therapeutic ideas that have been advanced, some of them most fantastic. In a scientific meeting I have heard the actual cautery, static electricity, and strapping advanced as a means of cure. Massage may be mentioned only to be condemned. The Roentgen rays have their advocates. Personally I am sceptical of their efficacy, but it is always unwise to condemn off-hand a new and powerful agent, of whose true properties one is ignorant. The application of any substance whatever to the skin over the affected joint can serve no purpose other than to entertain the patient and possibly his medical adviser. This would include hydrotherapy and the action of heat and cold. We have already discussed the subject of drugs in joint tuberculosis.

Abscesses.

The most frequent complication met with in the treatment of tuberculous disease of the bones and joints is the so-called tuberculous or cold abscess. The treatment of these abscesses has varied in the past from the most vigorous and radical measures to a policy of no treatment at all. If a collection of fluid locked up within the joint (especially within the hip) cause pain by the intracapsular tension, a thin scalpel may be thrust above the trochanter into the joint, to relieve the tension, or the joint may be aspirated under strict aseptic precautions. If the abscess be without the joint and of small size, deeply located, not painful, and not increasing in size, it may be let alone and possibly it will spontaneously disappear. If the abscess be rather large, or if it appear to be approaching the surface, it should be aspirated, under cocaine, and perhaps injected with one of the iodoform mixtures.¹

A tuberculous abscess should never be opened and drained, for it will almost certainly become infected sooner or later, and will then take months or years to heal, and will substitute, as we have seen, a wide tuberculous area for a small tuberculous focus. Abscesses of the hip and spine can usually be kept from rupturing, but those of the smaller joints and of the superficial bones are much more liable to infection, and will probably rupture in spite of anything that can be done to prevent it. Bier of Berlin has elaborated a treatment of tuberculous abscesses differing radically from that given here.

Sinuses.

This troublesome complication, the result of secondary infection of tuberculous abscesses, has long been recognised as a stumbling-block in the treatment of joint disease, and only recently has any progress been made in its successful treatment. Frequently of great length, tortuous and branching, the exact course of the sinuses has been impossible to determine. With the tubercles deep in their walls and with a bone defect at their bottom, they have defied eradication by the knife or by the curette. They can exist for years, and then can give rise to amyloid degeneration of the viscera. No pains should be spared to prevent the formation of these sinuses. Abscesses, instead of being curetted and drained, should be emptied and immediately closed. This can be done by opening them, and then immediately sewing them up, or, better still, by aspiration.

¹Calot's formula: iodoform 5, kreasote 2, ether 50, olive oil 50. Others use 10 per cent. emulsion of iodoform in glycerin.

When once a sinus has formed, there are two well known means of treatment open to us, injection with pastes after the method of Beck of Chicago, and Bier's hyperæmia—"Stauungshyperæmie."

Bismuth Paste Injections.—Dr. Beck of Chicago found that after injection of these sinuses by bismuth paste for radiographic purposes,

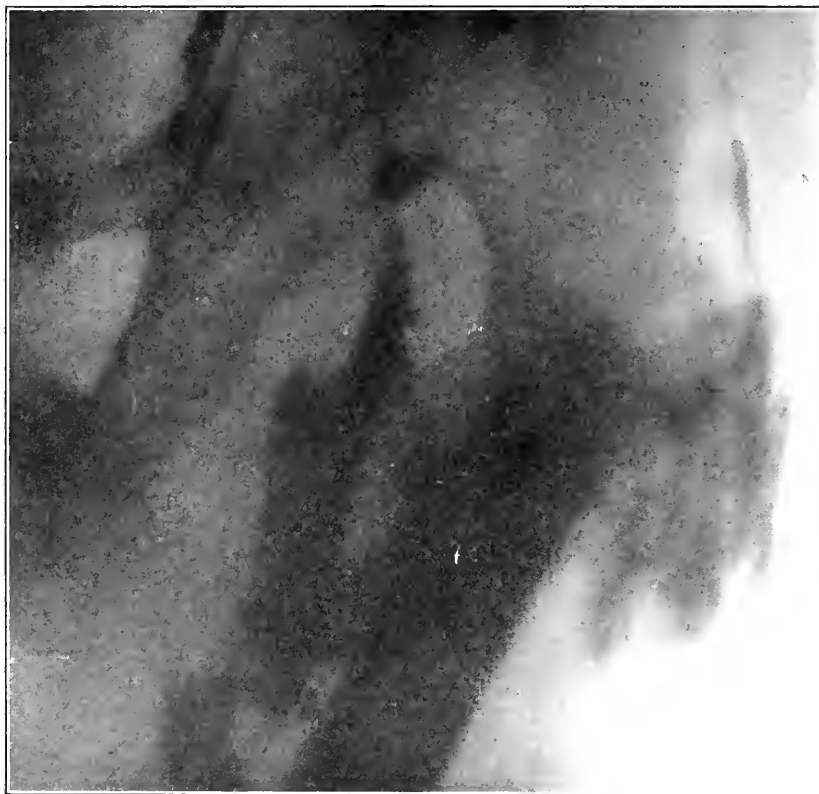


FIG. 34.—Old hip-joint disease in adult. The process had been considered healed for years, and was manifest by the appearance of a cold abscess. Note wandering of acetabulum. The dark shadows are caused by bismuth paste. The abscess had been opened and had become secondarily infected. The results of the paste in this case seemed marvelous.

some of them healed. Acting on this hint he began the practice of injecting sinuses with a direct curative purpose. His work has been taken up by others with encouraging results, which have been published in numerous articles. From our own experience we feel justified in saying that the treatment has beneficial results in some cases, and will

probably secure a permanent place in the treatment of tuberculous joints.¹

At first Beck used paraffin and white wax in his mixture, but afterward discarded them in favour of a paste composed of one part of subnitrate of bismuth to two of vaseline. These ingredients are made into a thoroughly homogeneous mass, and great care is used to prevent the access of any water. The mixture is then heated in a water bath, and is injected into the sinus with as much force as the patient can tolerate, as soon as it has cooled enough, that is, as soon as it feels only warm to the back of the hand. A large glass syringe is recommended, boiled, and afterward washed out with alcohol.

The mouth of the sinus should be wiped with alcohol before injection, and the mouths of communicating sinuses should be stopped with gauze. As soon as the syringe is withdrawn, a dressing should be clapped on to prevent the escape of the paste. Contrary to the claims of its author, the procedure is apt to be painful.

The melting point of this mixture is so near the normal temperature that if there be any damming back of secretion, the resulting fever causes a liquefying of the paste, and its automatic discharge.

We agree with Beck that if a sequestrum be present the paste will be useless. It is also useless in the presence of visceral involvement, and is of more use in old infected sinuses than in newer ones.

Dr. Beck's conclusions are as follows:²

1. A successful surgical operation for tuberculous sinuses or fistulas depends principally upon an exact knowledge of the extent, direction, and number of sinuses before the operation is undertaken.

2. Radiographs obtained by previously injecting the sinus with a bismuth paste show distinctly the origin and extent of sinuses. Such radiographs should always be taken before an operation is decided upon.

3. Tuberculous sinuses, fistulous tracts, abscess cavities, including empyema, can be cured by injecting them with a 3 per cent. bismuth vaseline paste, and in most cases surgical operation becomes unnecessary.

4. The formation of sinuses and fistulous tracts may be prevented by opening cold abscesses, evacuating the fluid, and at once injecting a quantity (not exceeding 300 gm.) of 10 per cent. bismuth-vaseline paste, and not sealing the opening.

5. When sequestra are present, the injections should be tried for a

¹Ely. Results of the use of Bismuth Paste in Tuberculous Sinuses at Sea Breeze Hospital. *American Journal of Surgery*, January, 1910.

²Emil G. Beck. The Surgical Treatment of Tuberculous Sinuses and their Prevention, Transactions of the Sixth International Congress on Tuberculosis, 1908.

reasonable length of time, and risky operations should be reserved as a last resort.

6. Bismuth subnitrate is a bactericidal, chemotactic substance, which is slowly absorbed and slowly eliminated. Injections up to 100 gm. of the 33 per cent. paste produce no toxic effect. In large doses it may produce symptoms of intoxication, such as ulcerative stomatitis, black border of gums, diarrhœa, cyanosis, desquamative nephritis, and loss of weight.

7. While these injections are effective in all suppurative sinuses and cavities, those of tuberculous origin respond to them more readily.

8. The secretions from sinuses change their character after the injection, becoming seropurulent or serous, and micro-organisms gradually diminish and often disappear. Tubercle bacilli are no exception.

9. This method of treatment is applicable to the suppurative accessory sinuses of the head.

10. Patients regain their general health, and gain rapidly in weight after the sinuses are closed.

Iodoform-wax Plugs.

For filling up defects in bone Mosetig-Moorhof¹ uses a mixture made up of finely powdered iodoform, spermaceti, and oil of sesame. This is heated until it becomes fluid at 50° C., and is thoroughly stirred. The cavity in the bone is carefully dried, and is then filled with the mixture, which soon solidifies.

Finally, let it be said that a soft, fluctuating, painless, chronic swelling appearing in the limbs or on the back is probably a cold abscess, and that to plunge a knife into such a swelling, without an exhaustive attempt to make an exact diagnosis of its nature and of its origin, is inexcusable.

Ankylosis.

A certain amount of stiffness and of limitation of motion almost always remains after a joint tuberculosis has run its course, or indeed while it is still active, but when this stiffness amounts to a complete or almost complete lack of motion we speak of an ankylosis—from “*agkulos*,” crooked. There is some confusion in the use of this term. Some reserve it for those cases in which there is actual bony union in

¹ Mosetig-Moorhof. “Strict asepsis. Equal parts of spermaceti and oil of sesame are melted in an evaporating dish, then sterilised in a water bath; 40 gm. of finely powdered iodoform (not crystallised) are put into a sterile flask, and 60 gm. of the hot, fat mixture are added, under constant agitation. This agitation must be continued without interruption until the mass solidifies. The melting point of the plombe is between 45 and 48 Celsius. . . . Before using, the plombe is to be heated in a cold water bath . . . to a little above 50 C.” (Surgery, Gynecology and Obstetrics, vol. iii, 1906, p. 547.)

a joint, with absolute immobility, others recognise degrees, and speak of true or bony ankylosis and of false or fibrous, or again of complete or incomplete. There is only one form of ankylosis in which there is absolutely no motion, and that is bony. In fibrous ankylosis the obstruction to motion may be in the joint itself or in the structures outside it—tendon sheaths, contracted muscles, etc. I believe Lorenz was the first to call attention to the important part played by the extra-articular structures in the ankylosis at the hip. If the joint is ankylosed in a vicious attitude, where the limb can be used little if at all, then one speaks of a *joint contracture*.

Treatment.—If a case of joint tuberculosis in its active stages presents itself for treatment, and we find the limb in a vicious attitude, our first duty will be to correct the deformity, and this we will do with the utmost gentleness and care, in order to avoid the trauma that results from rough handling. We may adopt any one of three methods: 1. Traction in bed in the line of deformity, gradually changing the direction of the traction, as the deformity yields. 2. Immediate reduction, using an anæsthetic to relax all muscular spasm, and perhaps dividing some of the contracted extra-articular structures. This method is liable to abuse, unless very carefully done. 3. Gradual correction of the deformity by a succession of plaster bandages, straightening the limb a little at each stage.

If the disease have run its course, it will be necessary to ascertain whether the ankylosis is fibrous or bony, and for this one depends on the Röntgen rays or on an examination under ether, or on both.

Let us first suppose a *fibrous ankylosis*. The limb may be in a good attitude or in a faulty one. If the former, our wisest course is to let it absolutely alone. We have seen that the joint surface of the cartilage is fibrous, that the synovia is thickened and fibrous, and projects into the joint like a plug (or muff, as Lagrange beautifully puts it), that the ligaments are shortened and degenerated, in short, that everything in the joint represents an effort at cure, *by depriving the joint of motion*. We shall bear in mind also that somewhere in this mass of fibrous tissue there probably lurk encapsulated foci of tuberculous material, ready, if released, to start up afresh the entire disease. To inject oil into this mass of fibrous tissue (there is practically no joint cavity) seems futile, to adopt any means to undo Nature's cure seems unwise. Doubtless old tuberculous joints have been successfully limbered up by passive motion, or have been mobilised by the insertion of animal membrane or muscle flaps: But doubtless also many others (I speak from humiliating experience) have been lighted up afresh, and have disseminated the disease throughout the body.

If fibrous ankylosis have taken place in a faulty attitude, and if it be not too rigid, we proceed as if the disease were still active. If the ankylosis be very firm we adopt the same measures as if it were bony.

Bony Ankylosis.—If the limb be in the correct attitude, or nearly so, we refrain from interference, if in a faulty one we do an osteotomy, perhaps aiding the reduction of deformity by the division of extra-articular structures. In doing an osteotomy it is well to choose one of the methods that does not involve the division of bone close to the joint; otherwise we run the risk of chiseling into an old, cheesy, tuberculous focus. After the osteotomy the joint is put up in plaster of Paris in the corrected attitude and is kept in this dressing for a number of months.

A successful osteotomy, following bony ankylosis, finishes our task. If the ankylosis be fibrous, the tendency to increase of deformity in the joint may persist, and may render a second operation necessary after some years.

The fear of producing an ankylosis of a joint by immobilising it, is unfortunately wide spread. In the face of much good authority I wish to emphasise as strongly as possible the fact that immobilisation never causes ankylosis. The changes in a joint caused by putting it at rest are temporary, and disappear when motion is resumed. Ankylosis is the result of disease or of injury. To allow motion or to practise passive motion with the idea of preventing ankylosis is an error.

Radical Treatment of Tuberculous Joints.

In former days, before the nature of appendicitis or of cholecystitis was understood, the treatment of peritonitis was diverse and at times most unscientific. With increasing knowledge the diversity has disappeared, and now we know in a general way, not only how to deal with the disease when it occurs, but usually how to prevent its occurrence. Differences of opinion may exist as to time of operation, technique, etc., but the broad underlying principles of operating have been well established. These may be changed or modified hereafter, but in the meantime the great majority of surgeons will follow them out as they have been laid down. One cannot imagine one operator neatly removing an appendix and sewing up his wound, and another curetting the organ and leaving the contents of the gut to drain into an open peritoneal cavity, while still another permitted all his appendix cases to run their course under expectant treatment, because, perhaps, he had seen one or two patients in whom the organ had ruptured into the intestine, and in whom nature had worked a cure.

This is exactly the state of affairs in the radical treatment of tuberculous joint disease, and until some method based on scientific principles can be devised, each man will continue to operate in the way that his own personal experience teaches him is best. Personal experience is not a reliable guide. Possibly if we return to the pathology we may find a better one, bearing in mind that we are dealing only with adult joints.

We have learned:

1. Unmixed tuberculosis exists only in certain connective tissues, possessing peculiar cellular elements—epithelial, epithelioid, lymphoid, etc., cells.

2. In the bones it exists only in the marrow.

3. It exists not in all marrow, but only in the marrow of spongy or cancellous bone.

4. The marrow of spongy bone, (red, lymphoid, or cellular marrow) differs from that of compact bone (yellow or fatty marrow) in that it possesses a large number of various cells. Other than this there is no essential difference between dense bone and spongy bone, except the quantity of bony material and the arrangement of the lamella.

5. The only other tissue in the joint liable to unmixed tuberculous inflammation is the synovia, and it also consists of a great number of peculiar cells.

From these facts we draw a working hypothesis that the red marrow and the synovial membrane must stand in some sort of causal relation to the disease.

We have learned further:

6. It is futile to remove at random a portion of the diseased tissue from a tuberculous joint, with a curette or otherwise. In those cases in which this was done, perhaps with the idea that nature might "take care" of the diseased material left behind, as one operator expressed it, the procedure was not justified by the results.

7. It is rarely possible by any method of operating now in vogue to eradicate the only two tissues of the joint that are vulnerable to a purely tuberculous inflammation, *i.e.*, the synovia and the red bone marrow.

8. All resected knees, in which bony ankylosis was secured without secondary infection, are cured. This result followed whether the operator made a thorough dissection of the synovia and a strenuous effort to eradicate the disease from the bone, whether he made a less thorough dissection and took away less bone, or whether, disregarding the tuberculous tissue entirely, he simply removed enough from the ends of the bones to secure ankylosis. (Three cases.)

9. It is easier to deprive the knee-joint of function than any other joint in the body. It is easier to cure the knee-joint of tuberculosis by a resection than any other joint.

From 7, 8, and 9 we draw the conclusion that these resected joints were not cured by removing all the diseased tissue from them, but that some change must have been produced in them by the operation that rendered them no longer vulnerable to the disease. What is this change?

After a resection of the knee-joint, with resulting ankylosis, the synovia undergoes a fibrous change and loses its peculiar cellular structure, and the epiphyses of the femur and tibia change from spongy bone to dense bone, and the red marrow changes to yellow marrow. Eventually a central medullary canal may be formed at the site of the former joint¹ and the femur and tibia may become one long hollow shaft. In other words, there is here no longer either of the only two tissues that could possibly be invaded by the tuberculous granulations, or could form a lodging place for those already there. The disease disappears because it has no feeding place.

This canalisation is well shown in three skiagrams of a tuberculous knee which had healed after a prolonged mixed infection, with bony ankylosis. The patient was a child of about twelve years of age, and the skiagrams were taken at intervals of about one year. The second shows a piling up of bone about the periphery, and an extension upward of the medullary canal of the tibia. The third shows this process still more distinctly.

This subject of the operative cure of tuberculous knee-joints is so important that we may well go into it at some length. Other writers have already called attention to the fact that the complete removal of all tuberculous tissue was not a necessity in knee-joint resections.

The three cases to which we alluded under 8 are as follows:

CASE 1.—S. L., age twenty, stenographer. The patient had been

¹ Ollier. *Dict. encycl. des sciences médicales*, Paris, 1870. Ankylose, p. 191. "Les os une fois sondés il s'opère une raréfaction de leur tissu au niveau de l'articulation; les deux canaux médullaires s'abouchent et ne forment plus qu'un canal unique. Toutes les parties placées en dehors du mouvement par suite de l'ankylose s'atrophient. Les saillies situées autour de l'articulation et servant d'insertion à des muscles, diminuent et même disparaissent. Ces observations prises sur des pièces du Musée Dupuytren se rapportent aux ankyloses osseuses."

Pl. Maclaure. *Nouveau Traité de Chirurgie*, Paris, 1909. Ankyloses, p. 235. "Tantôt c'est une fusion osseuse complète à la fois périphérique et centrale; aussi la cavité articulaire a disparu, et les os sondés sur toute leur étendue ne font plus qu'une masse unique. La substance spongieuse des épiphyses peut disparaître; les vacuoles dont elle est parsemée s'agrandissent, et les canaux médullaires des deux extrémités osseuses ankylosées peuvent se réunir de manière à ne présenter qu'un canal osseux médullaire commun et continu d'après Lacroix."

Lagrange. *Traité de Chirurgie*, 1901. "Le tissu spongieux vers les épiphyses ne présente plus le même aspect; on dirait que les lamelles osseuses se sont portées vers la périphérie et qu'elles s'y sont accumulées en une lame compacte joignant les diaphyses des os sondés. Dans quelques cas, par suite de la raréfaction du tissu central, les deux canaux médullaires ont de la tendance à se réunir; mais c'est l'exception. Le plus souvent, en effet, il reste encore des traces de démarcation entre les deux os. On peut d'ailleurs ne rencontrer que quelque tractus osseux allant d'un os à l'autre."

under conservative treatment for four years with what was supposed to be a tuberculosis in his left knee, and one year previous to his admission to the hospital, following a course of "Stauungshyperemie," a large amount of fluid had been evacuated from the joint, and the ligamenta alaria, enormously thickened, had been partially trimmed away. Permission could never be obtained for a resection. There



FIG. 35.—M.M. Old healed knee-joint tuberculosis in a child. Bony union following secondary infection and prolonged suppuration. X-ray taken in 1909 at the age of about thirteen. (Reproduced by permission of the editor of *Surgery, Gynecology and Obstetrics*.)

was very little motion in the knee, but this motion was painful, and I undertook an operation at the Metropolitan Hospital with the sole purpose of stiffening the knee. On April 1, 1908, the joint was opened by an external lateral incision, and the external condyle of the femur and the opposing tuberosity of the tibia, somewhat roughened as to their cartilages, were vigorously scraped. The hypertrophied synovia,

removed where it could be easily reached, showed under the microscope marked villous enlargement and proliferation, but no signs of tuberculosis. At no time had there been any tendency to posterior subluxation nor to circumarticular thickening. The diagnosis was therefore changed, and the patient, after wearing plaster of Paris for several months, was discharged.



FIG. 36.—M.M. Old healed knee-joint tuberculosis. X-ray taken in 1910. Observe the change in the bone structure at the old level of the joint—a condensation about the periphery and a prolongation of the medullary canal of the tibia upward. (*Reproduced by permission of the editor of Surgery, Gynecology and Obstetrics.*)

The painful motion persisted, and at length forced the patient to return and to consent to a resection, provided very little bone was sacrificed. A von Pirquet test gave negative results.

The third operation was done by Dr. Brewer at the Roosevelt Hospital in April, 1909. The external condyle was found tightly bound to the tibia by fibrous bands which tore apart at operation.

The patella, the extreme ends of the femur and of the tibia, and a part of the synovia were removed, the bone ends were drilled and were sutured with chromicised cat-gut, and the wound was sewn up with silkworm gut, with drainage. Plaster of Paris completed the dressing. Healing was practically by first intention, but for several months after



FIG. 37.—M.M. Old tuberculosis in knee-joint of child. Same case as Figs. 35 and 36. Note canalisation of joint and disappearance of bony prominences. X-ray taken in 1911 at about the age of fifteen.

the operation the scar would break down at some spot and a piece of cat-gut would be extruded. In March, 1910, appears this note. "No sign of disease, firm, bony union at about 165° ." A letter from the patient in January, 1911, contains the information that there has been no recurrence of the disease, and that he has gained 14 pounds in weight since the resection.

The laboratory examination showed apparently normal bone, which cut quite hard. The external condyle showed the old adhesions torn off. The synovial membrane was thickened, and the joint surface of the patella was covered by dense fibrous tissue. "At the side of the patella is a warty-looking body about 1 cm. in diameter, which feels harder and firmer than the surrounding tissue, and on sec-



FIG. 38.—Resected tuberculous knee of young adult. Case I, about 2 years after resection. Note density of bone.

tion has an appearance suspicious of tuberculosis." All slides of the soft parts made by me were negative, except those of the warty growth; these showed typical tuberculosis. The Roosevelt laboratory reported: "Soft parts riddled with tuberculosis." The bone sections showed normal bone. Obliterating endarteritis was present.

Here is a case, probably of *purely synovial tuberculosis*, cured by the removal of just enough *bone* to produce an ankylosis.

CASE 2.—G. D., teacher, age forty-five. This patient had been

seen four and one-half years previously, and had refused a resection of his tuberculous right knee. The joint had slowly grown worse under various forms of treatment, and at length forced him to return. At the time of operation the knee was extremely painful, thickened, and almost immovable, but without open sinuses. I determined to put my theory to a practical test, and to do a resection with the sole object of securing an ankylosis, disregarding absolutely the tuberculous tissue.

On December 20, 1909, I opened the joint by an incision across the patella, sawing through the bone. The knee was found badly diseased, the synovia greatly thickened and hypertrophied, and the cartilages eroded at their margins. I sawed off about 1 2 inch from the condyles of the tibia, chiseled off the inner surface of the patella, the corresponding surface of the femur, and the very tops of the tuberosities of the tibia, and then sewed up the wound with deep cat-gut and superficial silkworm gut, using a cigarette drain. Dry gauze and plaster of Paris completed the dressing. The drain was removed in twenty-four hours. I did not divide the crucial or lateral ligaments, and used no sutures, wires, or nails for the bones. Only enough of the synovial membrane was taken away to give a good exposure, and no attention was paid to the disease in the bone except that a pocket of soft granulations was lightly scooped out from the head of the tibia. No chemicals were used that could be thought to influence the disease, such as iodoform, iodine, or carbolic acid.

The wound healed promptly except for some superficial granulation. The patient wore plaster until May 23, 1910. On July 1, 1910, the knee was firmly ankylosed at an angle of 165° , and the patient was walking on it. It was apparently completely cured. A letter dated November 29, 1910, says that the leg has been useful during the summer for walking through woods and over rocks, and that its owner walked nine miles on it a few weeks before he wrote the letter.

The laboratory examination showed typical tuberculosis of the synovial membrane, but very little damage to the bone except at the spot noted above, and directly under the cartilage.

Here then is a case of extensive synovial disease, later involving the bones, cured by removal of just enough bone to produce a firm ankylosis.

CASE 3.—Forty-seven years of age. Elevator man. This was a case of rather short duration, but acute onset. On February 26, 1910, I resected the right knee at the Metropolitan Hospital through an incision across the patella, removed the patella, sawed off the condyles, and proceeded as in the last case except that I did not use any drainage.

The saw passed directly through a focus in the external condyle about 1 cm. by 5 mm. in diameter. No soft parts were removed whatever except a clipping of the hypertrophied synovia for diagnosis.

The patient wore his plaster for about 8 months. He was seen one year after the operation by Dr. Albee of New York, who writes as follows: "The skin is entirely healed. No sinuses. There is slight motion at the knee when force is exerted. . . . The result is all right."

The laboratory examination showed marked rarefying osteitis in the neighbourhood of the bone focus, but no tuberculosis. The synovia showed typical tuberculosis.

Here is a case of a focus in the bone, accompanied by a tuberculous synovitis, cured by the production of a bony ankylosis.

We have demonstrated, then, conclusively that removing at random part of the diseased tissue from a tuberculous knee does not effect a cure, that it is practically impossible to eradicate all the diseased tissue from a tuberculous knee, and that a bony ankylosis following a resection of a tuberculous knee (provided no secondary infection have taken place) is equivalent to a cure, and this whether much of the diseased tissue has been removed, very little, or none at all. It follows, then, that in the radical treatment of tuberculous knees the one main indication is to obtain bony ankylosis without secondary infection.

In tuberculous hips we find much the same as in tuberculous knees except that their radical cure can be effected in either one of two ways, by the production of a bony ankylosis, or of a dislocation, with a sacrifice of much or of little of the head of the bone. In the latter case we get what Ollier calls "Articulation par suspension." The stump of the femur is swung by fibrous tissue up on the dorsum ilii, and the joint as such ceases to exist. There can certainly be no eradication of all the diseased tissue here, no matter how vigorous the interference may be, and curetting and draining simply expose the joint to secondary infection.

Operating on this plan I have resected two tuberculous hips, merely scraping perfunctorily the acetabulum and removing just enough of the head of the femur to produce a dislocation. Both were of rather long duration. In each the head of the femur was badly eaten away, and the stump was lying in tuberculous pus. In neither was secondary

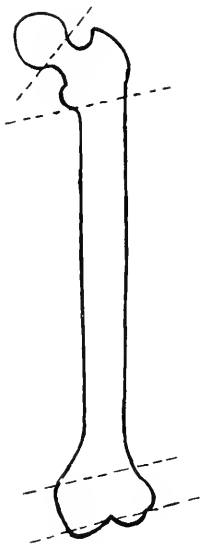


FIG. 39.—Diagrammatic representation of the amount of bone sacrificed in the classical resection of the hip and knee, and in resection by the author's method.

infection present. Both were demonstrated as tuberculous under the microscope, and in both primary union was secured. Both patients recovered with a useful limb. In the second case I made the mistake of spiking the stump of the neck fast to the pelvis. The spike later caused suppuration, sloughed out, and left a tuberculous sinus that was finally closed with injections of bismuth paste. It afforded me a useful lesson on the subject of spikes, nails, and wires in tuberculous joints.

If the cure can be brought about either by ankylosis or by dislocation, it follows that it is not anything in ankylosis itself that brings it about, but that it is essentially the destruction of the joint. The synovia and the red marrow owe their presence here to function in the joint, and if function be removed they disappear. If they disappear the disease cannot exist in that locality. Without them there can be no such thing as joint tuberculosis.

Tuberculosis of the adult tarsus. In the case of a bony focus in one of the tarsal bones, if an early diagnosis be made and if the bone be removed before synovial invasion, the disease can be cured. If one of the extensive synoviae be involved, it is well known that, as a rule at least, nothing but an amputation or a very extensive resection affords much hope.¹ This is because no way has been devised to bring about a change of the red marrow to yellow, and a disappearance of the synovia. The same may be said of the carpus, of the ankle, and of the vertebræ.

Of the elbow and shoulder my specimens do not enable me to speak positively. Probably in the former the matter stands as in the hip, that is, cure by fibrous union or by bony ankylosis; in the latter the cure is usually effected by bony ankylosis.

If, then, the synovia and the red marrow are the only two tissues of a joint that are vulnerable to tuberculosis, if their presence there is dependent upon function, if they disappear when function is removed, it follows that in the radical cure of a tuberculous joint our object should be *to deprive the joint of function*.

One other rule must be observed: *Avoid secondary infection*. Ordinary connective tissues are immune or almost so to tuberculous invasion. If a secondary infection be added they lose this immunity, and become vulnerable. The walls of a tuberculous sinus which have not been secondarily infected may show signs of a violent inflammation, but no tubercles.² In the walls of an infected tuberculous sinus tuber-

¹ Oscar Wolff. Ueber ausgedehnte Resectionen am tuberculösen Fuss. Archiv f. clin. Chir., liii, 8, 304.

² One of our specimens, a tuberculous tarsus, shows this beautifully. The case is described in the Journal of the A. M. A., Oct. 8, 1910.

cles are abundant. A bony defect in a tuberculous joint, infected with pus germs, is notoriously hard to heal in. The difficulty of healing an infected tuberculous sinus is also well known.

We are compelled to grant that tuberculous joints may possibly recover after any form of operation or after no operation at all, as may any other disease. I realise, also, that to prove the connection of the red marrow and synovia with tuberculosis is practically to prove a universal negative, but to one who weighs the evidence carefully these two rules in the radical treatment of joint tuberculosis must stand out clearly:

1. Deprive the joint of function.
2. Avoid secondary infection.

These are the simple rules to be observed in joints which are not already the seat of a secondary infection.¹ If infection with pus germs have taken place the problem is much more complicated. In this case the disease has spread to other tissues previously immune, or practically so, and a much wider resection may be necessary, unless the suppurating tracts and bone cavities can be filled up with Beck's paste or some other mixture. Therefore it is an excellent plan, before proceeding to the resection of a secondarily infected tuberculous joint, to make a persistent effort to heal up the infected sinuses. If the infection be a severe one and if the ends of the bones be very badly diseased, it is sometimes hardly worth while to attempt a resection. An amputation might be preferable. Pulmonary disease is no contraindication unless of a very severe degree.

He who opens a tuberculous joint with the idea of finding the diagnosis written in plain language within is doomed to frequent disappointments. In my own operative work I must confess to many errors, and my opportunity to pass in review in the laboratory the work of many other men, skilled in clinical surgery and some in pathology, has shown that errors are common to most, if not to all. Some joints show plainly their nature, others do not. The synovia may be studded with tubercles, and again it may not. I have mistaken a bone cyst for a tuberculous bone focus. Velvety proliferation of the synovia may or may not be tuberculous. The spawn-like synovia, supposed to be

¹ Ludloff in discussing results from operative intervention in joint tuberculosis, lays down these conclusions:

1. Tuberculous arthritis is often the only tuberculous focus in the body.
2. The treatment should aim to eliminate the disease focus. The preservation of function should be a secondary consideration.
3. Every operation should be radical. It is better to abstain than to do an incomplete operation. The prognosis in patients incompletely operated is worse than in those not operated at all.
4. The osteal foci should be treated radically, the synovial conservatively. The mixed focus should be operated.
5. Resections in the knee, the elbow, and the foot give good results, in the hip, bad results. On the Operative Treatment of Articular Tuberculosis. *Centralbl. f. Chir.*, 1909, No. 9.

characteristic, was found in one of our non-tuberculous specimens. The cartilage merely shows evidence of disturbed nutrition, and many of the changes in it may be counterfeited in other diseases.

Other Theories of Operating.

It may be well to turn our attention to other theories and methods of operating.

Most advocates of radical treatment have emphasised the necessity of removing all the infected tissue. We have seen that this is usually an impossibility, and that the cures that are brought about by these very extensive resections are brought about in spite of the fact that diseased tissue is left behind.

Macnamara,¹ Poore,² Huntington,³ Roth,⁴ and others have advocated, especially in the larger joints, the hip and knee, the so-called focal operations, whereby in early cases, with a bony focus, before the involvement of the joint cavity, one might "tunnel" down to the diseased bone, and remove it, thus securing a rapid cure. For the exact location of the disease one depends on the clinical signs and on the Röntgen rays. These writers have adduced cases to prove their contentions, but in many instances the cases are not authenticated. We have seen, also, that there is no way of telling before operation or during it just how far the tuberculous process has advanced, and that when it is of so great an extent in one place as to affect the nutrition of the bone sufficiently to show in a skiagram, it has usually advanced in the marrow far beyond this spot.

Poore did this operation upon eight children. Two recovered rapidly, the other six came to an excision. The tuberculous nature of the disease in the two cured cases was assumed by the operator because "Their histories were such as to leave no doubt as to the nature of the disease—articular osteitis." He believed that he had erred in not operating earlier.

Huntington has reported three cases of the tunneling operation for hip-joint disease, none of which was demonstrated as tuberculous, and in fact the study of the case histories leads one to believe that all three were distinctly of a non-tuberculous nature.

Noble-Smith and others also have published cases.

Sherman,⁵ who has done the operation a number of times, in a very

¹ Macnamara. Diseases of the Bones.

² Poore. N. Y. Medical Journal, April 23, 1892.

³ Huntington. American Journal of the Medical Sciences, vol. cxxx, p. 22, Surgery, Gynecology, and Obstetrics, vol. ii, p. 409.

⁴ Roth. Buffalo Medical Journal, June, 1909.

⁵ Sherman. California State Journal of Medicine, March, 1907.

able paper has shown that it is impossible to tell before operation, not only how far the disease has spread, but even whether or not it has involved the joint. He says: "A tuberculous lesion is practically always more serious and more extensive than the outside evidences lead one to believe."

Synovectomy, arthrectomy, "erosion," at one time held quite a vogue in tuberculous joints, but has fallen into disrepute.¹ It consisted



FIG. 40.—Bone tuberculosis. Note the two isolated tubercles, surrounded by apparently healthy marrow. They are merely a part of an extensive disease in the bone. This photomicrograph shows well the futility of attempting to eradicate the disease with a curette. The ordinary bone curette, magnified proportionally, would be about as large as a shovel.

in the removal of all the diseased synovia, together with such bone foci as appeared during the operation. It was hoped that by this operation the disease might be eradicated from children's joints without the disturbance in growth that follows a typical resection; but this hope was not realised, and a further disadvantage appeared in the resulting distortions of the limb. Subsequent contractures could

¹ See Watson-Cheyne. *Tuberculosis of the Bones and Joints*, 1895.

Ebermayer. *Diss.* München, 1905.

Ebermayer. *Zur Behandlung der Gelenktuberkulose nebst einer Statistik über 104 Arthrektomien*, *Ann. d. Städtischen allg. Krankenhäuser zu München*, 1907, xii, 216.

hardly be prevented. The operation is more difficult than a typical resection, and seems to possess no especial advantages.

To refute those who believe in invariable radical measures or those who believe in invariable conservative treatment, no evidence that I possess will suffice. He who believes that the diseased joint represents the entire disease in the body, and that it must be attacked with the utmost vigour in patients of all ages, even if all the infected tissue cannot be completely removed, will doubtless continue to practise the most radical means at his disposal. To such an one I would say that his only logical operation is an amputation.

He who regards the tuberculous joint as a mere local manifestation of a general disease, and refuses on that account to operate, should, to be logical, direct his entire attention to constitutional treatment and should refuse to avail himself of any means of local treatment whatever. Possibly it is the fallacy in the arguments of one extremist that has raised up extremists on the other side. When those who practise invariable radical treatment become more conservative, the conservatives may become more radical.

SECTION II.

CHAPTER I.

TUBERCULOSIS OF THE SPINE, CARIES OF THE SPINE, POTT'S DISEASES, CARIES SPINALIS, SPONDYLITIS.

Tuberculous disease of the spine is classified, according to the region involved, into cervical, thoracic, lumbar, and sacral. Sacral disease alone, without involvement of the joint with the ilium, is very rare. Disease of the sacro-iliac joint will be considered in a chapter of its own.

In the main the pathology of tuberculosis of the spine is that of bone tuberculosis anywhere in the body, but there are certain peculiarities of the process due to the structure and arrangement of the bones and of their cartilages, that have a direct bearing upon the course of the disease, and hence merit a special description.

It is necessary to clear our minds of much of the confusion that exists on this subject. Much that has been written is mere guess work. From the inaccessible location of the vertebrae it follows that we are rarely able to observe the beginnings of the disease, and are forced to reach our conclusions from a study of autopsy specimens.

If we would understand the process it is only necessary to study the structure of the bones and joints of the spine. In a general way each vertebra is made up of a body, composed almost entirely of spongy bone, and of an arch and various processes which contain a much smaller proportion of spongy substance, being covered with a compact tissue of considerable density in some places (Quain's Anatomy). Besides this, each vertebra has four joints with synovial cavities.

This is all that is necessary for a comprehension of the essentials of the tuberculous inflammation. The red marrow of the spongy bone, and the synovia of the joints furnish a field for the start of the disease and for its spread. The processes, composed largely of dense bone (with yellow or fatty marrow), are not involved to so great extent as are the bodies.

In the bodies, therefore, the disease mostly exists, spreading sometimes from one to another until several have been involved. The exact manner of this extension is fairly well known. It could, of course, readily take place through the articular processes, for here we have a joint that differs in no essential from other joints of the body.

where the extension from one bone to another is well understood, but it is doubtful if it often does extend in this way.

Between the bodies are the intervertebral discs, fibro-cartilages whose fibres attach directly to the vertebral bodies without the interposition of any synovial cavity. As soon as the nutrition of these discs has been destroyed, they disappear, bare cancellous bone is apposed to bone, and the spread of the disease from one vertebra to another would be perfectly simple, but until the fibro-cartilages disappear they should offer a barrier to the disease.

It is thought that the tuberculous granulations find their way to the periosteum on the front of the bodies, and pass along in the innermost cellular layer of this to the next vertebra, but I have never had the chance to examine any specimens of spinal caries under the microscope, and of my own knowledge I am unable to confirm this.

A lateral twist of the spine, sometimes present in Pott's disease, is generally regarded as due to a greater involvement of one side of the body of a vertebra, but this is probably not the case. It is much more likely to be due to an involvement of one of the true synovial articulations. In fact, so long as these articular processes are uninvolved, no matter what portion of the body of the vertebra be diseased, the deformity can be in only one direction, and that is antero-posteriorly, the vertebrae swinging on the articular processes as on a hinge.

The disease, then, runs most of its course in the bodies of the vertebrae. As it progresses, the framework of the bone (the trabeculae) is killed by the interference with its nutrition, and the structure, which has borne the superincumbent weight transmitted through the vertebra above, collapses; but the entire vertebra cannot collapse at the same time. The articular processes, located behind the body, composed largely of dense bone with its yellow marrow invulnerable to the disease, remain intact, and act as a hinge on which the two bodies swing together. This is the cause of the angular deformity, more or less characteristic of the disease, a deformity which is accentuated by the spinous processes projecting backward and swinging apart on the hinge, as the bodies coalesce.

Now, the spine is a flexible column whose curves are adapted to the maintenance of equilibrium in the erect attitude. Any change in the curve at any part necessitates a compensatory curve at some other part of the column; hence the compensatory curve in Pott's disease above or below the seat of the disease, or both above and below.

This angular deformity or kyphosis can reach a very pronounced grade, more especially in the thoracic region where the normal curve has a convexity backward, until finally the segments of the column

above and below the disease may form a right angle with each other. The chest is deformed, and the thorax may be tilted down until the lower ribs rest in the flare of the ilium. As a result of this the abdominal and thoracic viscera are displaced, compressed, and functionally damaged.

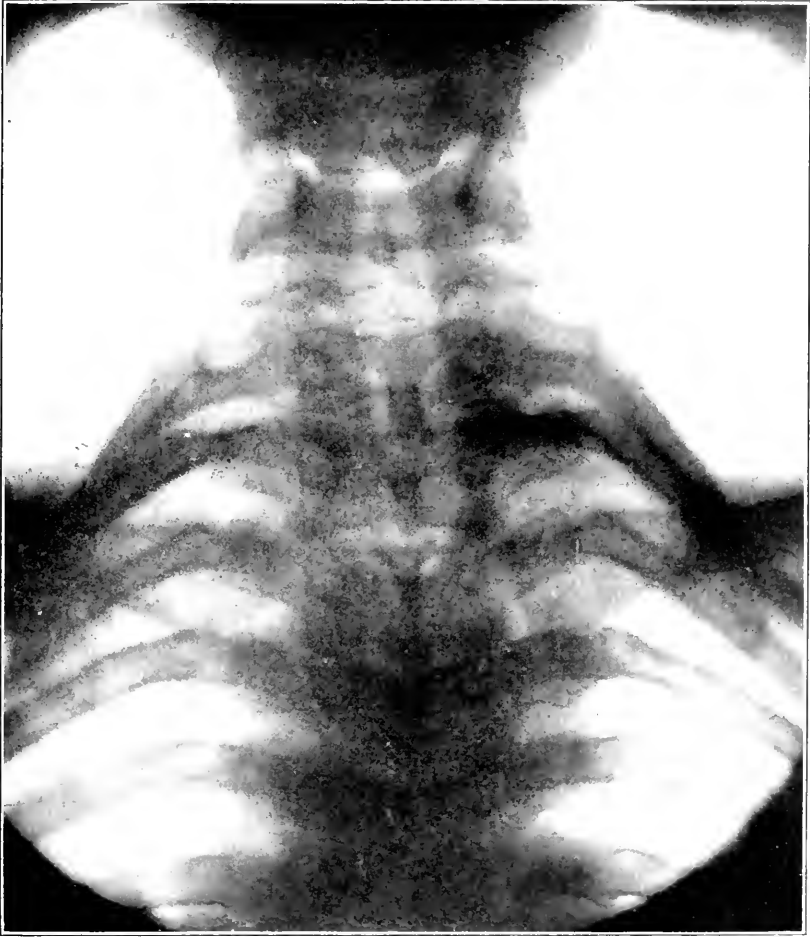


FIG. 41.—Tuberculosis of the 7th cervical vertebra

The distortions and deformities of the trunk and neck will depend upon the region of the spine that is involved. At the angle of deformity in the spine the spinal canal is often narrowed, not so much by the actual bony projection into it as by the inflammatory products of

the disease, often, it is said, a true pachymeningitis, and a "compression myelitis" results, involving the part of the cord distal to the lesion.

The cure of a tuberculous spine is brought about by fibrous tissue and by bony union.

"Periosteal bone formation (periosteitis ossificans) accompanies foci situated in the cortex, especially those foci which are secondary to a tuberculous arthritis. A periosteitis accompanies foci situated in the vertebræ, and frequently large defects in the vertebræ are bridged over by newly formed bone. The periosteum produces bone in tuberculosis of the phalanges, metacarpal and metatarsal bones, giving rise to the clinical picture of spina ventosa." (Lexer-Bevan. General Surgery.)

Occasionally the disease affects the arches of the vertebræ. In this case one finds, according to König,¹ shallow areas under the periosteum, and cheesy, granulating foci with small sequestra, similar to the defects found in carious ribs. Abscesses occurring on the posterior surface of the trunk are usually due to disease of the arches of the vertebræ.²

Caubert³ has collected twenty-seven cases of tuberculosis of the coccyx. Of twenty-five cases in which the sex of the patient was noted, sixteen occurred in men. All were followed by circumanal abscess and fistula.

These are the essentials of the pathology of Pott's disease, and if they be held firmly in mind, and if a knowledge of the anatomy of the spine and of the neighbouring structures be added to them, it will be easy to understand the course of the disease, the symptomatology, treatment, etc. Otherwise these will appear as so many disjointed, incoherent facts.

Abscesses.

Abscesses in Pott's disease, caused as they usually are by disease of the bodies, present on the anterior aspect of the spine, and find their way by gravity and the line of least resistance along the fascial planes to the surface. According to Witzel and A. Schmidt their course is as follows:⁴

¹ König. Lehrbuch d. spec. Chirurgie, 1899.

² Wieting observed involvement of the posterior parts of the vertebræ in nine cases out of seventy, and operated upon five of them. Two patients recovered, one died of chloroform, one improved, and one was unimproved. He gives the points of differential diagnosis as follows: sensitiveness to pressure, but no pain on motion of the joints of the spine. The swelling of the abscess appears directly in the middle line, and then, having pierced the fascia, spreads under the skin. The abscesses remain more or less localised, that is, they do not "wander." The kyphosis is absent. Ueber die Tuberculose der Wirbelsäule, besonders ihrer hinteren Abschnitte, Archiv f. klin. Chir., Bd., 71, S. 419.

See also Schultess and Luning. Atlas und Grundriss der Orthopaedie, 1901.

³ Tuberculosis of the Coccyx. Revue de Chir., 1904, ii.

⁴ Georg Müller. Die Orthopaedie des praktischen Arztes.

Abscesses of the upper cervical vertebrae extend first behind the pharynx, then behind the oesophagus, distend the mucous membrane of the wall of the pharynx, and often give rise to symptoms of suffocation, which disappear as soon as the pus is evacuated. On the other hand they may cause death. Further the pus usually sinks, comes to rest upon the larynx, causing interference with the respiration and difficulty in swallowing, presses the larynx and trachea forward, and then, leaving the retrovisceral cleft with the inferior thyroid artery emerges in the great lateral cleft for the vessels. Here it distends the lateral aspect of the neck on both sides of the sterno-mastoid and ruptures; or it may pass along the axillary plexus into the axilla and rupture there.

Abscesses of the lower cervical vertebrae sink at first along the same path, and, passing into the posterior mediastinum, follow the aorta downward, and appear on the thigh.

Abscesses of the thoracic vertebrae, forming in the posterior mediastinum, very rarely break through the pleura into the lung, but sinking along the aorta and the common iliac, reach the pelvis and stay there usually for a while, and then pass either in front of the femoral vessels or behind them, into the thigh—ilio-femoral abscesses. Now and then they escape from the pelvis through the great sciatic foramen, and appear in the gluteal region.

Abscesses of the lumbar vertebrae usually follow the course of the psoas muscle, penetrate and destroy that muscle, and, passing under Poupart's ligament, appear external to the femoral vessels.

Most abscesses follow these paths, but all sorts of deviation can take place—into the lungs, pleura, intestines, bladder, scrotum, quadratus lumborum, etc. Sometimes the abscesses disappear without ever reaching the surface.

Symptomatology.

The symptomatology of tuberculosis of the spine is that of tuberculous disease generally, but, like the pathology, it suffers some modifications from the structure and location of the bones. As the diseased portion of these is located usually in the front of the column and very deeply, whatever *swelling* is present will be toward the visceral aspect and will not be perceptible. So also *local sensitiveness* cannot be elicited except in the rare instances when the arches of the vertebrae suffer. Hence the uselessness of prodding the back of the spine. Sensitiveness to pressure is more frequent in cervical disease than elsewhere. Some authorities assert that sensitiveness may be elicited

by grasping the spinous process between the fingers and moving the vertebrae upon one another, but this symptom, at best, is unreliable.

The *pain* in Pott's disease is essentially a referred pain. It is caused by irritation of the spinal nerves, and inasmuch as one is accustomed to refer to the periphery sensations coming in over these nerves, so here the pain is referred to the periphery, and to that area of the periphery supplied by the nerves running into the cord about the seat of disease. In disease of the upper cervical, for instance, the pain may be felt in the neck; of the lower cervical and upper thoracic, in the arms; of the lower vertebrae, in the chest, abdomen or lower extremities. The irritation may manifest itself as pain in the stomach, or in the abdomen (and may be regarded as indigestion or "worms") or in the hip or lower extremities. A girdle sensation, or a feeling of constriction about the chest, is quite frequent.

The pain may be a dull ache, or it may shoot with great severity around the trunk or down the limbs. Sometimes it comes in agonising paroxysms and doubles the patient up on the floor. Night cries are almost pathognomonic. As a rule, pain is the first symptom of the disease, possibly the only one for a long time. An examination of the region in which it is experienced reveals nothing, and mysterious "rheumatism" is called in to explain the problem. As the disease progresses the pain increases and becomes more constant. Sleep is one long nightmare, and every unguarded movement brings on a spasm of agony. The face of the patient betrays his apprehension and terror.

This is a typical picture. On the other hand, pain may be almost entirely absent, even with extensive disease.

In very young children one of the earliest symptoms may be the refusal of the child to walk; in older children, a desire to keep quiet.

In thoracic disease a peculiar, futile cough may be present, or a grunting respiration.

Muscular spasm, stiffness, limitation of motion, and impairment of function. These four blend with one another to such an extent that they may be considered together.

The *muscular spasm* is to be regarded essentially as a conservative symptom, as nature's effort to put the parts at rest. To it at first may be ascribed the stiffness, limitation of motion, and impairment of function. The spasm causes a feeling of stiffness, which in the early stages of the disease is present in the morning and wears off during the day. It causes a certain stiffness in the spine which manifests itself as a peculiar attitude of the trunk, the shoulders, or the neck. The patient moves about in a guarded manner, perhaps walking on his toes to

relieve the spine of shock. When he stoops, the back is not bent as in a normal individual, but at some part, at least, it is held stiff or rigid.

If the cervical spine is diseased the head may be twisted to one side or tilted down or backward, perhaps simulating an ordinary torticollis. If the middle thoracic region be affected the shoulders may be held with a peculiar "squareness." Occasionally in acute disease lower down, the patient in sitting will put his hands on the seat to steady his body. In low cervical and high thoracic disease the chin is often tilted up, in high cervical it may be depressed until it rests on the sternum. In lumbar disease the patient often leans back, as does a pregnant woman.¹

To bring out this stiffness well, it is necessary to put the diseased portion of the spine through its normal motions. If the disease be in the neck we shall best elicit the symptom by attempting to move the head about, and shall observe where its mobility is affected. If the lumbar spine be the seat of the trouble, when the patient bends well forward the concavity does not change to a long convexity as in the normal spine, but persists, or at the most becomes a straight line, restricting the bending or preventing it altogether. A coin or a key may be thrown upon the floor, and instead of bending forward to pick it up, the patient will flex his knees and hips, and with perfectly rigid spine will dip down with trunk erect and pick up the object at his side.

In the thoracic region the stiffness may show in a slight change of the normal curve, a flattening where there should be a convexity, but often in thoracic disease the rigidity cannot be made out with certainty, and a kyphosis, which occurs early in this region, will be the only deformity perceptible.

If a child be laid upon his face on a table and his pelvis be lifted, the rigidity and muscular spasm in his lumbar and lower thoracic spine may easily be demonstrated. The old custom of striking the child on the top of the head or of making him jump from a table is quite unnecessary, though the latter is sometimes done as a last resort when one is practically sure that no disease is present. Nothing should be done in the examination to aggravate any existing trouble.

It is not necessary to detail the exact change in attitude caused by disease in all the various vertebræ. An intimate acquaintance with the normal attitude enables one to detect any deviation from it.

Deformity.—It will be seen from the foregoing that the muscular spasm and stiffness sometimes give rise to a certain amount of deformity, but this deformity will often disappear when the spine is put for a while at complete rest. The real, permanent deformity that

¹ Bradford and Lovett. Orthopædic Surgery.

occurs in Pott's disease is due, as we learned in the pathology, to a destruction of bone, and manifests itself as a kyphosis or convexity backward. This kyphosis appears earliest and is most striking in the region where there is normally a backward convexity, namely in the thoracic spine, but sooner or later, unless early and persistent treatment be instituted, it will appear also in lumbar or cervical disease. In the acute stages the deformity is almost always a sharp prominence, a "knuckle," later on it often rounds off. It may be caused by the divergence of the spines of two vertebræ and by the coalescence of their bodies, or it may involve several. In a cured case, the kyphosis is almost invariably rounded off.

Sometimes the antero-posterior deformity will be accompanied by a lateral twist. Indeed, the lateral deformity may be the first to appear, especially in adults. It is frequent in thoracic disease.

In some cases the kyphosis is the earliest sign of the disease, and may be the prime cause of consulting a physician, but usually it is preceded for some time by pain and by stiffness. In adults the disease may exist for a long period without any visible bony deformity.

Psoas contraction is a frequent symptom in Pott's disease, caused, as a rule by an abscess lying upon the sheath of the muscle or in its substance. The contraction causes flexion, abduction, and external rotation of the thigh, giving rise to a marked limp and to lumbar lordosis. Its presence may be elicited in two ways, *i.e.*, by laying the patient on his face and attempting to superextend the thigh, or by laying him on his back with his lower extremities hanging over the edge of the table. Psoas contraction will prevent the affected thigh from dropping as low as the sound one.

Abscesses have been discussed under the section on pathology. If deeply located and small they may cause no symptoms, if of large size they give rise to pressure symptoms—difficulty in swallowing, dyspnoea, pain in the lower extremities caused by pressure on nerves, psoas contraction, etc. They can be seen bulging into the wall of the pharynx, and if of considerable size can be felt in the iliac region or even in the flank. One is rarely surprised now-a-days by their appearance in the front of the thigh; one detects them before they have progressed thus far. If they reach the surface and become secondarily infected they give rise to the symptoms of an ordinary abscess anywhere, *i.e.*, pain, fever, etc.

After rupture and infection, abscesses may discharge for years, and in the end may cause death by amyloid degeneration of the viscera, miliary tuberculosis, etc.

Pott's paraplegia is essentially a compression myelitis, due to pres-

sure on the cord at the seat of the disease, usually in the cervical or upper thoracic, more rarely in the lower thoracic or lumbar spine. It is a spastic paralysis, affecting the lower extremities, as a rule. It begins generally with a slight unsteadiness and weakness in walking, and progresses, unless efficient treatment be instituted, or even in spite of treatment, to complete inability to stand, and sometimes to complete motor paralysis. The knee-jerks are increased unless pressure be on their centre in the cord, when they may be diminished or lost. Ankle clonus is usually present. In severe cases the sphincters of the bladder and of the rectum are affected, causing incontinence of urine and of faeces.¹

In mild cases, properly treated, the paralysis may clear up in a short time, but usually it lasts for months (six to twelve) and rarely may be permanent. Motion is affected much more than sensation, but paresthesia or anaesthesia may be present. Occasionally this symptom-complex is the one that first leads the patient to seek medical advice (in adults especially), and many cases of Pott's paraplegia have been mistaken for cord lesions alone, with no thought whatever of the bone disease underlying them.

Diagnosis.

The diagnosis of Pott's disease cannot be made upon the subjective symptoms alone. These, as well as the history of the case, may be suggestive, and may decide the question after a thorough examination of the patient, but the main reliance must be placed upon physical signs—the kyphosis, the muscular spasm, the attitude of the patient, abscesses, etc. The x-ray is not of great use in the diagnosis, except in disease of the cervical vertebrae.

A kyphosis means the destruction of part of a vertebra. It occurs with spinal fractures, but in spinal fracture the history will differ from that of cases of Pott's disease. Tuberculin tests have the same confirmatory value as in the other joint lesions, but no more.

In case of doubt the same rule holds here as elsewhere: put the joints of the spine at rest and await developments. Err always on the safe side. If a child complain of pain in his chest, belly, or lower extremities, if he sit or walk stiffly or carry his head abnormally for any length of time, strip him naked and examine his back. If an adult have a spastic gait, never make a diagnosis of spinal cord lesion without examining his spine.

¹For an excellent description of Pott's paraplegia see Painter and Moore, *Journal of the Am. Orthop. Assn.*, vol. viii, No. 2.

Differential Diagnosis.

Rotary-lateral curvature is accompanied by little pain, if any. Severe cases may cause an ache or a tired feeling in the back. Lateral curvature is a postural deformity, not a disease; hence subjective symptoms will be slight or absent. The curve is not only lateral, but it has a twist also which throws the ribs into prominence on one side of the back (best seen when the patient leans forward) and makes one shoulder high or one hip prominent. The curve is often S-shaped. No knuckle or kyphosis is ever present on the spine, nor can muscular spasm be detected. The apex of the deformity is always on the ribs—also best seen when the patient bends forward.

Rickets.—In a young child with severe rickets the continuous sitting posture necessitated by his weakness causes a long posterior curve, often with more or less angularity in the thoracic region. This curve may be somewhat fixed, but as a rule if the child be laid prone, his hips be raised from the table, and the kyphosis be pressed in with the palm of the hand, the curve can be obliterated or almost so. In addition, the child will present other evidences of rickets. I have never seen tuberculosis and rickets in the same patient.

The postural round back of adults, more or less fixed and rigid, is rarely mistaken for Pott's disease, but the converse is not always true. In adult thoracic Pott's disease the deformity is occasionally rounded rather than angular, it may simulate the ordinary round back, and it may necessitate two or three examinations for its differentiation, but it will present more symptoms of pain and disability, and a history of a shorter existence. The development of a typical round back is usually a matter of many years.

Various ankylosing affections of the spine, whose pathogenesis and classification have not yet been satisfactorily worked out, spondylose rhizomelique, arthritis deformans, osteo-arthritis, etc., cause a long, posterior, rigid curve affecting the joints of the spine generally, or possibly sparing those of the atlas and axis. With these may be classed the cases following certain infectious diseases, as influenza and gonorrhœa. All these occur almost exclusively in adults, and convert the spine into one long, immovable curved rod. The pain may simulate that of Pott's disease, running down the legs or about the trunk, but no muscular spasm can be detected, and there is no tendency to abscess formation.

Typhoid spine, with its muscular spasm, rigidity, and severe pain, occurs in young adults and is sometimes accompanied by deformity.

Its comparatively acute onset during convalescence from typhoid fever makes its nature clear.

Lumbago, due to strain or to "exposure to cold," is acute in its onset, and is usually of comparatively short duration. There are cases of persistent lumbago or pain in the lumbar region, however, whose nature may remain for a long time obscure. In order to rule out Pott's disease prolonged observation may be necessary. The same may be said of persistent sciatica, especially bilateral.

Spinal fractures cause an angular deformity which may simulate exactly that of Pott's disease. In some instances paralysis and spasticity in the limbs may ensue. The diagnosis is to be made upon the distinct history of trauma followed immediately by the deformity and by the other symptoms. Before the injury there must have been no symptoms referable to the spine. A skiagram is of great assistance, especially in injury of the cervical vertebrae.

Sarcoma is more rapid in its course than tuberculosis, and causes a more diffuse, rounded, irregular deformity, not following the spinous processes, and often sensitive to pressure. A skiagram may show extensive destruction of bone. It is very rare. *Carcinoma* occurs as a metastasis of a growth elsewhere, and is accompanied by agonising pain not relieved by rest.

Appendicitis may cause psoas contraction, but is more sensitive to pressure than is psoas abscess, is more acute, and shows a leucocytosis and a rise in temperature, possibly also a history of previous attacks.

Hip disease is characterised by limitation of motion of the hip in all directions, while in psoas contraction with Pott's disease, extension, adduction, and inward rotation will be the motions limited.

In *torticollis*, whether "rheumatic" or caused by inflamed lymph-nodes, such motions as put the muscles involved, usually the sternomastoid and trapezius, upon the stretch, will be painful and limited, and the deformity will be typical of their contraction, whereas in tuberculosis of the cervical spine the muscular spasm and limitation of motion will be more general. Torticollis following trauma is often caused by a fracture of one of the cervical spinous processes, and may readily be detected by the Röntgen rays.

The flexion of the head in *diphtheritic paralysis* can be easily corrected manually, without pain, but as soon as the support is removed, the head again falls forward. No limitation of motion nor muscular spasm accompanies diphtheritic paralysis.

Spinal Neurosis, Hysterical Spine.—The subjective symptoms of

this are out of all proportion to the objective. While a certain sort of muscular spasm may be present, it will disappear when the patient's attention is diverted. The same may be said of sensitiveness to pressure. This diagnosis should never be made in young children, nor even in adults until we have exhausted every means to find some organic lesion.

Prognosis.

In children this is decidedly good if efficient treatment be followed through to the end, and bad otherwise. Among the poor, in whom the affection is by far the most frequent, the demands upon the parents in time and trouble are so great that their faithful co-operation is hard to secure. They float from clinic to clinic, alternating care with neglect, possibly paying a visit to some faith cure meanwhile, and ostentatiously throwing away their apparatus, only to reappear later at the dispensary.

Disease of the cervical region on account of the proximity of vital structures (phrenic nerve) has an added danger, but runs a shorter course, and has a better prospect of complete ultimate cure, possibly from the fact that there is in the cervical vertebrae less spongy bone and less red marrow.

The duration ranges from a minimum of about two years in cervical, and three and four years in thoracic and lumbar disease, up to double these periods or more. Sometimes in patients thought to have recovered, the subsequent appearance of an abscess will convince us of our error.

The duration is apt to be underrated in dispensary practice. At Sea Breeze Hospital where we could surround the patient with every attention and could carry through the treatment *secundum artem*, we calculated upon a duration of about five years in an ordinary thoracic or lumbar case, and discharged the patients with a spinal support, urging its regular renewal.

Bony deformity, once having taken place, is usually permanent. By strict attention to details and by vigorous measures the hump may sometimes be made smaller, but it is much easier to prevent the hump than to obliterate it.

In adults the prognosis is uniformly bad. While recovery is perhaps possible, it is at best very rare. I have grown to regard Pott's disease in an adult as practically hopeless. His tissues appear to have no power to resist its spread, and to repair the damage done.

Treatment.

Treatment in every case in adult or child is conservative. The diseased bone of the anterior portion of the vertebrae is difficult of access, and even if we could reach it, operative treatment would be quite useless. It is a practical impossibility to eradicate all the diseased marrow (and the synovia of the intervertebral articulations) and unless we could devise an operation that would change the character of the marrow from lymphoid to fatty our interference would be fruitless. This is the reason that radical operations are generally unsuccessful and have been almost abandoned, except in the rare instances of involvement of the arches. In disease of this region, radical measures have a few advocates.

The keynote of all treatment is rest. Individual opinions may differ as to the best means of securing this, but the principle is almost universally recognised. There can be no effective traction maintained for any length of time, though one may relieve the cervical vertebrae of a part of the weight of the head in disease high up in the column. We simply secure as complete an immobilisation of the spine as we can, and continue this until the disease is well.

The means of doing this are three in number: 1. Recumbency. 2. Some form of brace or corset. 3. Plaster jackets.

Recumbency.

Simple recumbency in bed relieves the bone of weight-bearing, and secures a certain amount of rest, but the immobilisation is only partial, and it is necessary to reinforce this treatment by some form of rigid appliance. Numbers of these have been devised, *i.e.*, the cuirasse, plaster-of-Paris bed, etc., but probably the best are the Bradford frame and the modification of this devised by Whitman.

The Whitman-Bradford frame consists of an oblong gas-pipe frame (calibre 1 4-1 2 inch), with ordinary elbows screwed on at the corners. The length of the frame is the height of the patient plus 6 to 8 inches, and the width, the distance between his shoulder-joints. The frame is provided with a removable canvas cover which laces up the back, and is strapped to the top and bottom pipes to prevent wrinkling. If the frame be tightly wound by circular turns of a muslin bandage, before the canvas cover is put on, a greater rigidity can be secured. An apron over the thorax and abdomen, with straps of webbing at its sides fastens to buckles on the posterior aspect of the cover, and holds the patient in place. If the patient be a child, a piece of rubber sheeting may



FIG. 42.—The Whitman-Bradford frame.

be made fast to the canvas cover to prevent soiling, and a pad of felt may also be sewn on at the seat of disease to provide a firm point of support. If superextension of the spine be desired the frame may be bent backward at the level of the kyphosis.

The patient is never permitted to sit up for an instant. He can be rolled off the frame on to a table, to afford access to his back, and scrupulous care should be taken to keep his skin clean and dry. Every day his back should be bathed with alcohol and should be well dusted with powder. A bed-pan or even an ordinary dust-pan is thrust under the buttocks to receive the urine and fæces. If a child manifest a tendency to roll over with his frame and to walk off on his hands and knees, a board tied across the top or bottom will be found useful.

Recumbency is *par excellence* the treatment for very young children—under three years—for patients with large abscesses, psoas contraction or paraplegia, and for all children during the early stage of the disease, or even in the later stages where much pain is present.

Braces and Corsets.

These are made of all sorts of materials, aluminium, tin, shavings and glue, celluloid, etc., but in this country the brace that enjoys the widest popularity is that known as the Taylor brace, made of steel. It consists essentially of two parallel steel bars, about 1 inch to 1 1/2 inches apart, running along the vertebral column on each side of the spinous processes, and connected by two or three steel cross bars. To these are fastened buckles which attach by straps to an apron in front. The steel bars derive their support from a pelvic band below. The Taylor brace is primarily intended to prevent antero-posterior deformity. In cervical or upper thoracic disease some form of chin-piece or head-piece is added.

Probably the Taylor brace or some modification of it is as effective as any form of mechanical spinal support yet devised. In using it one must bear in mind that it is simply a splint, and must see to it that it reaches well above the diseased vertebrae and below them, in order to exert a proper antero-posterior leverage upon the trunk—upon the trunk and head. The brace should fit snugly but not too tightly for comfort. Properly fitted, it is a very efficient means of ambulatory treatment, with discharging sinuses of the trunk probably the most efficient at our command. The details of the construction and application of the Taylor brace may be found in works on orthopaedic surgery.

Plaster Jackets.

The plaster-of-Paris jacket, since its introduction by Sayre, has steadily grown in popularity, and now forms the standard appliance in the treatment of the tuberculous spine. Its most enthusiastic advocates are those who have used it most. Its advantages are its cheapness, its rigidity, and its stability. It is not complicated, does not get out of order, and cannot be removed without the knowledge of the surgeon. True, it needs skill and practice in its application, but so does every other form of apparatus except the Bradford frame. It is somewhat more likely to produce excoriations of the skin than is the steel brace, but these can usually be avoided with care. The main contraindication to the use of the plaster jacket is the presence of sinuses opening on the trunk.

The plaster jacket, like any form of appliance for the treatment of Pott's disease, depends for its efficacy entirely upon the skill with which it is put on, and upon the materials of which it is composed, and to one who has seen the absurd plaster dressings masquerading as jackets, the criticisms of the plaster jacket are quite comprehensible.

A jacket is an irremovable splint intended to hold the joints of the spine immovable, and, like a splint, it must reach well above and below the seat of disease, in order to obtain proper leverage. Like any other splint, again, it must be properly padded, and must be comfortable. It must fit snugly, but it must not be too tight. It is usually put on while the patient is suspended, or partially so, in order to have the spine as straight as possible. An assistant is advisable, but not absolutely necessary if the patient be tractable.

First a snugly fitting shirt, or a section of shirting reaching from the neck to the ankles, is drawn over the head or feet, and inside of this are run two strips of linen, or of muslin bandage in front and behind—the so-called “scratch bandages” of Lorenz. Two cuts are made in the shirting above, at the sides, in order that it may be drawn up well over the shoulders and knotted there while the jacket is being applied. This shirting affords a smooth lining, and the bandages beneath it are to be drawn up and down every day in order to keep the skin in good condition. This will be assisted by an abundance of dusting powder.

Next comes the padding. This preferably consists of felt, and is to be applied over the bony prominences. Two pieces of corn-plaster felt, about 6 or 8 inches square, are cut out for the crests and anterior-superior spines of the ilia, and two long strips, about 3 inches wide, to reach from top to bottom in the middle line, anteriorly and posteriorly.

only. Two oblong pieces of piano felting, about 12 inch thick, 6 inches long, and 1 inch wide are cut out to be placed on each side of the kyphosis. They must be thick enough to keep the protruding bone from rubbing on the plaster. They press against the lateral masses of the vertebrae.

The head-sling is now adjusted, either one of the usual type, or, better still, the one devised by Calot, and then the patient is suspended, and the rope of the suspension apparatus is pulled tight enough to raise him upon his toes, but not to swing him clear. His hands grasp the "spreader" above his head.

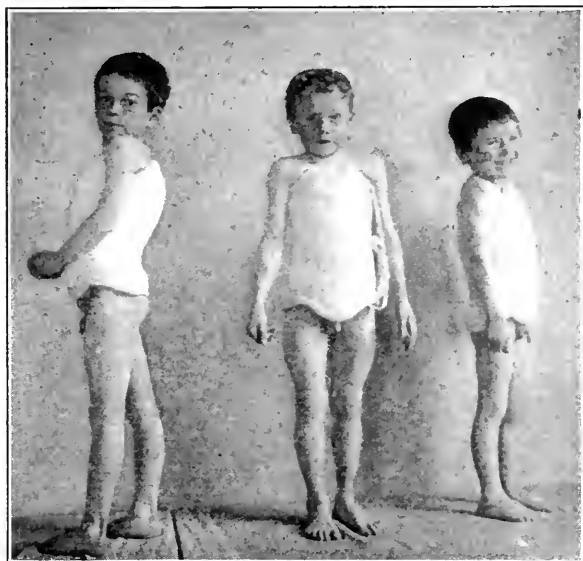


FIG. 43.— Ordinary or old-fashioned jackets. Observe how the jacket on the left fails to control the deformity.

The surgeon, sitting behind the patient, adjusts the padding, and then applies the bandages, very smoothly, and rubbing in each layer so as to make one homogeneous mass, and molding the whole carefully over all bony prominences. Great care must be observed in the application of the first bandage to prevent wrinkling. The inside layer of the jacket should be perfectly smooth. While one bandage is being applied the next stands upright in a pail of warm water, and each one is wrung out fairly dry as it is removed from the pail.

The plaster, as it is put on, reaches from the throat to a point below the pubes, and while it is hardening, and while the patient is still suspended, it is trimmed off above and below with a sharp knife.

Above, the cut starts about 1 1/2 inch below the sternal notch, goes outward, dips down under the axilla, and then rises a little to go across the back. Below, it starts just above the pubes, rises with concavity downward to permit flexion of the thighs, passes under the anterior-superior spines, and slopes downward, running across the lower margin of the sacrum.

If good plaster have been used, by the time the trimming is finished the patient may be released from the sling, and then he should either stand or lie upon his side for several hours. Sitting should be avoided until the plaster is thoroughly set. The knots in the shirting are then untied, and this is turned up and down over the plaster, and its borders are sewn together so as to make a covering as well as a lining.

The parents are instructed in the use of the scratch bandage, are cautioned against letting any object fall inside the plaster, and are told, when the first jacket is applied, that the patient is never to sit or stand from that time forward, without a spinal support, until the disease is cured. An excoriation under the jacket is immediately manifest by the foul odour. Hence the necessity for frequent smelling all over the trunk.

If the skin become excoriated, the jacket should be forthwith slit up the front, by means of a short butcher's saw and a jack-knife, and sprung off. By an arrangement of pads, or possibly by cutting a window in the jacket, the excoriated skin may be relieved of pressure, and the old jacket may be applied until the excoriation is healed, when a new jacket should be made. A good jacket with care will last from two to six months. Wetting must be avoided, for moisture destroys the plaster. In removing a jacket, a little water will greatly facilitate the task.

The ordinary jacket should be about 1/4 inch thick. The tendency is to make it much too heavy, but a little practice will enable one to judge as to the number of bandages necessary. About six or eight bandages, 6 inches wide, are the usual number for a child; for a good-sized adult the number may run up to eighteen or twenty.

If the patient experience discomfort after eating, by reason of distention of his abdomen, a folded towel may be placed over his epigastrium and umbilical region, under the shirting, while the jacket is being applied, to be withdrawn on its completion; or a circular opening may be cut in the plaster. Neither of these procedures is often necessary for a child.

For disease in the cervical region or in the upper thoracic, a jury mast or head-spring has been devised, whose lower part is incorporated in the back of the plaster jacket. It is at best an unsatisfactory appli-

ance, hard to adjust, and harder still to keep adjusted. A child will not tolerate it, and slips his head out from the supporting straps. In disease above the seventh thoracic vertebra, the ordinary plaster jacket is not the treatment of choice. It finds its greatest use in disease below the ninth thoracic vertebra.

Goldthwait of Boston has devised an apparatus for applying jackets in the supine position. It is especially useful in cases with a lateral deformity.

R. Tunstall Taylor¹ seats his patient on a bicycle saddle, extends the trunk, and with his "kyphotone" exerts pressure on the kyphosis while the jacket is being applied. He claims excellent results in the reduction of the deformity.

Some surgeons have recommended the prone position, with the patient lying in a hammock or on a sheet.

All these ideas may be adopted to fulfil special indications, but as a routine procedure, suspension is the most popular method.

The Calot jacket, introduced into this country a few years ago, has attained quite a wide popularity, and marks a distinct advance in surgery. It is invaluable in the treatment of Pott's paraplegia, is by far the best means of support for upper thoracic and for cervical disease, and is excellent in cases of Pott's disease with much deformity. Calot asserts that he can reduce the deformity, or can cause it to disappear entirely by means of his jacket, but our experience does not justify us in going as far as this. He teaches also that the jacket is very simple of application. Here we differ from him radically. We regard it as the most difficult form of plaster dressing to apply.

In regard to the manner of applying the jacket, we follow the rules laid down by Calot, with a few exceptions. We found that plaster made with cold water broke down in a few days, and we have substituted warm water. We use, also, bandages made previously with dry plaster, instead of rolling them in plaster cream. It would be well for anyone who has never applied one of these jackets to follow Calot's advice and to practise on a manikin before putting one on a patient. He will find that three assistants are advisable.

The Calot head-sling is a great improvement on the old-fashioned kind, and is made of canvas, 6 cm wide. To a circular piece about 168 cm. in circumference is sewn a tailpiece 104 cm. long. Measure the child's occipitofrontal circumference and add 2 cm. to this. Then measure off this distance on the circular part of the sling and insert safety pins. Into this middle part the child's chin and occiput fit, and the two loops beyond are carried up and hung over the transverse bar. This bar is

¹ Taylor. *Orthopædic Surgery for Students and General Practitioners*, 1907.

suspended from a hook and pulleys as in the old fashioned apparatus, and, while the jacket is being applied, the child's heels are pulled just clear of the stool on which he stands. The tailpiece of the sling starts

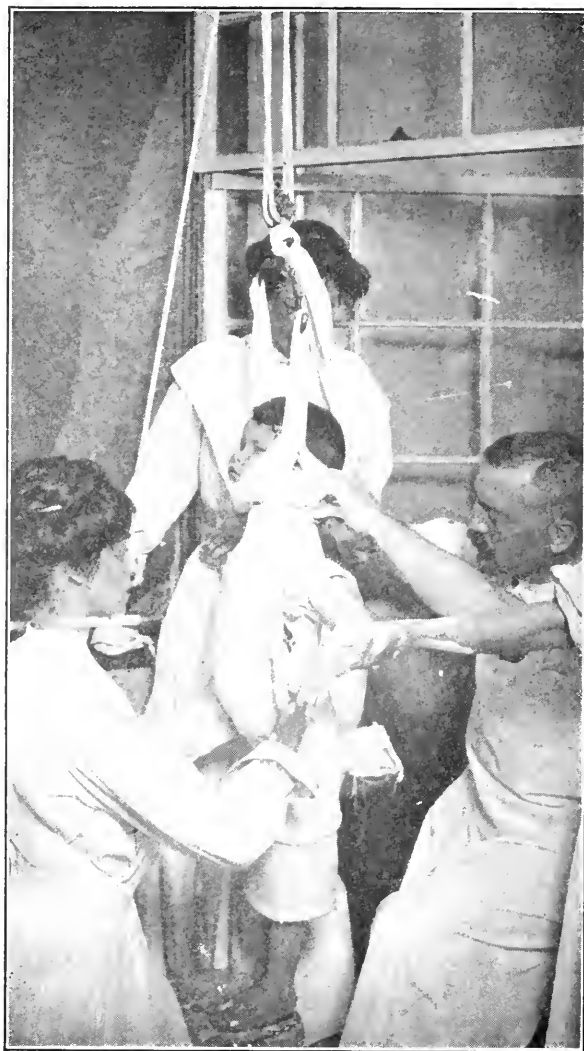


FIG. 44.—Application of the Calot jacket with "officer's collar"; trimming the jacket.

from the child's occiput and passes up to be attached to the middle of the transverse bar. It keeps the child's head from tilting backward. An assistant holds the child's hands at an angle of 45 degrees with his body.

The patient wears one, or better two, buttonless shirts, usually of stockinette, with sleeves. In the "grand" jacket one piece of stockinette reaches up over the head, and has a hole cut for the nose while the plaster is being applied. For the jacket with military collar we sew a collar of corn-plaster felt to the top of the shirt. A large, triangular pad of cotton batting about an inch thick is then held in place, by an assistant, over the sternum and the anterior aspect of the ribs; the pelvis is also lightly protected with a piece of corn-plaster felt, and, if the jacket is to be one with a military collar, one or two plaster bandages are smoothly applied, covering the trunk and shoulders and encircling the neck. The auxiliary pieces are then put on, as described below, and several bandages are applied outside of these. In a "grand" jacket the chin and occiput are also carefully padded, and the plaster bandages include the head also, avoiding the hole left for breathing.

When the plaster has been applied as quickly as possible, the surgeon and his assistant give their attention to molding it carefully all over the child's body, especially about the pelvis and shoulders. Through a small triangular opening over the sternum the cotton padding is then removed, and the jacket is trimmed off above and below. Above, with a military jacket, at the junction of the chin with the neck, with the "grand" jacket leaving the ears free and including the chin and occiput. Then the patient may be released from the sling and laid face downward over the edge of a table or bed. A nurse or assistant should watch his breathing for a while to see that it is not impeded.

About the end of forty-eight hours the jacket should be cut out in front as shown in the illustration. A window 6 by 3 inches should also be cut in the back over the kyphosis, and the shirt should be slit up by two cross cuts, the skin should be greased with vaseline, and oblong pieces of cotton wadding, a little larger than the window, should be tucked under the shirting, next the skin, by means of a spatula. This procedure drives the kyphosis forward. The shirt is then folded back in place, and the whole thing is held by a bandage—we use several plaster bandages.

At intervals of about two months this treatment of the kyphosis may be repeated. A jacket should last about six months.

The auxiliary pieces mentioned above consist of three or four layers of erinoline, impregnated with fresh plaster cream. For the military jacket they are three in number—two aprons, front and back, and a collar; for the "grand" jacket, two aprons, a chin-piece and a piece for the occiput. The aprons are the length of the trunk, plus one-half, and in width are equal to one-half the circumference of the

trunk. The anterior one is applied from the sternum to the pubes, and the redundant portion is folded up and applied over the lower abdomen. The posterior apron is slit up for almost half its length, making two tails, and these tails are brought over the shoulders and then down in front of the shoulders, back under the axillæ.

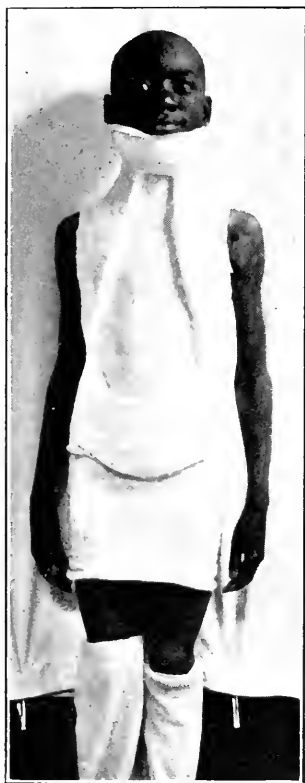


FIG. 45.—Grand Calot jacket. Anterior view. This was a case of subluxation of the atlas, wrongly diagnosed at first as cervical Pott's disease.



FIG. 46.—Grand Calot jacket. Side view.

An assistant stands by to nick the aprons with the scissors, if necessary, to make them lie smoothly; and, in fact, the same thing is advisable while the first plaster bandages are being applied. The collar is made about the height of the child's neck, and once and a half its circumference. It strengthens the jacket at this point. The pieces for the chin and occiput in the "grand" jacket should be about 4 by 6 inches, and should run downward from these points.

In disease above the seventh thoracic vertebra, or in disease at any

point complicated by paraplegia, the "grand" jacket is used; in other cases, the jacket with military collar.

The treatment of tuberculous abscesses in Pott's disease has varied in the past from an absolutely expectant one, to a vigorous opening, curetting, washing out, and draining. Under the expectant treatment many abscesses, even those of large size, disappear spontaneously, but, again, many others slowly approach the surface, become infected, rupture, and leave sinuses that discharge for years and add greatly to the dangers of the disease. This result almost invariably follows also the operation of draining and packing, and of recent years the custom of evacuating abscesses and of injecting them with some mixture has gradually been growing in favour.

Calot of Bercé seems to be the one who has carried out the method most thoroughly. We have followed out his ideas with some slight modifications and have obtained excellent results from them. He lays down this fundamental rule: "To open an abscess from a tuberculous spine or to permit it to burst, is to open a door through which death almost always enters." Further, he says that no abscess should be evacuated unless it can be easily reached, that it may be evacuated when it is readily accessible, and that it must be evacuated when it threatens to break through the skin.

For evacuation Calot uses a large hollow needle and an aspirator and, having emptied the abscess, while the trocar is still in place he injects the cavity by inserting the needle of an injecting syringe through the trocar. When the contents of the abscess are quite "ripe" he injects a mixture of olive oil 50, ether 50, kreasote 2, iodoform 5. When the contents are more solid he injects a mixture of naphthol-camphor 1, and glycerine 5-6. At each injection he uses 2-12 gm. of the mixture, and generally injects about twelve times, at intervals of one week.

In the ordinary iliac abscesses he thrusts his needle upward and inward at a point 2 cm. internal to the anterior-superior spine. If the abscess have reached a considerable size, the intestines are pushed by it away from the pelvis and are in no danger of perforation. To open a retropharyngeal abscess through the mouth is to invite sepsis and death. Calot punctures it under ether narcosis from the side of the neck, going in behind the sterno-mastoid at the level of the transverse process of the third cervical vertebra. The fluid injected is the iodoform mixture minus the ether ingredient, and in amount is one-fourth of the amount of pus aspirated. The operation is an extremely delicate one, and should be attempted only by one having a thorough knowledge of the anatomy of this region. For its exact description the reader is referred to Calot's book.

Instead of the solution of iodoform in ether, many surgeons, especially the Germans, make use of a 10 per cent. emulsion of iodoform in glycerine or in olive oil, injecting from 30 to 100 grams.

Iodoform is supposed to exert some sort of specific influence upon the tuberculous granulations in the walls of tuberculous abscesses and tracts. Whether it does this or not has by no means been proved.¹ Whether or not there are any tuberculous granulations in the walls of abscesses not secondarily infected is doubtful. Certainly they are absent in some cases; possibly they are absent in all. Excellent results have been obtained by the injection of bismuth paste.

We may eventually find that the good results in all these cases are due to the evacuation of the abscesses and to the mechanical effect of the subsequent filling of their cavities with some sterile substance.

Under the head of Bier treatment we have already discussed an entirely different method of abscess treatment, namely, that by making a small opening in its wall and afterward cupping it regularly. Good results have been obtained by this method, but personally I prefer to reserve it for the abscesses whose rupture seems inevitable.

In addition to the local treatment, the presence of a psoas or iliac abscess of any considerable size demands rest in the recumbent posture. Psoas contraction is best treated in the same way. If it be persistent, weight and pulley traction should be added. In an old case of neglected psoas contraction it may be necessary to divide the secondarily contracted muscles attaching to the anterior-superior spines (tensor vaginae femoris). The division should be done under ether, the thigh should be stretched out in complete extension, and a plaster-of-Paris spica should be worn for several months.

Pott's Paraplegia.—Recumbency is the treatment for this also, perhaps supplemented by a Calot jacket. Drugs are of no avail. The operation of laminectomy has been essayed, but the results have not been encouraging.

According to Menard, the paraplegia is due, not to the deformity of the spine or to the pachymeningitis, but to the formation of an abscess within the spinal canal. After softening of the vertebrae some writers maintain that the large abscesses in front of the thoracic spine, under pressure by the respiring lung, force their way through the column and exert pressure upon the cord. In this case Menard and Vassillief have done costotransversectomy with good results, draining the abscess. Goldmann² has done the operation in three cases, in two with a cure of the paralysis, but he says that the resulting lesions of the pleura and

¹ Vide Fränkel. Verhandl. d. deutschen Gesellsch. f. Chir., xxx. Congress, Central. f. Chir., 1901, No. 29.

² Goldmann. Munch. med. Woch., 1909, 45.

the formation of sinuses are not to be weighed against the relief of the paralysis. In this we should hardly agree with him.

In conclusion let me quote the excellent remarks of Bradford and Lovett summarising their ideas of the treatment of Pott's disease:

"The proper treatment of Pott's disease is not the application of any method, the use of any corset or brace, but the employment of such means as are most efficient for carrying out the object aimed at." (*i.e.*, rest, immobilisation, deprivation of function.) "A brace is useless in the case of persons unable to adjust it; a plaster applied about the trunk is useless in disease of the cervical or high dorsal region. Recumbency, carried to a point of depressing the patient's mental and physical condition, is as much of a mistake as to drag a patient about who is anxious to lie down.

"In the treatment of these cases, the surgeon should be familiar with the advantages to be gained by all methods, and should employ each as the case may demand, and for such a length of time as the circumstances of the case may require, or combine the different methods as may be advisable.

"In a general way he may formulate to himself that: In acute, painful cases absolute recumbency with proper fixation is the best method until the active stage of the disease is past; in middle and lower dorsal Pott's disease an immovable plaster jacket, without head attachment, in the case of negligent persons, is most available.

"Whether recumbency for a time is required, or whether ambulatory treatment with fixation appliance is sufficient, are questions of judgment in individual cases.

"A choice between plaster jackets and steel appliances is a choice between a fixed and a movable support. The former is better in the more acute forms of the disease. The latter requires constant and faithful attention to guard against imperfect or loose application and inadequate support.

"Apparatus carefully adjusted and applied is evidently preferable to removable plaster and other corsets, being less clumsy; but apparatus properly made is both more expensive and demands more skill and time on the part of the surgeon.

"In cases of Pott's disease the treatment involves much responsibility and cannot be left to a mechanic unfamiliar with the pathological conditions, as is sometimes done. The surgeon should familiarise himself with every detail and be responsible for this as well as for the general treatment."¹

¹ Bradford and Lovett. Orthoædic Surgery.

CHAPTER II.

THE HIP.

Hip-joint disease, *morbus coxae*, *morbus coxarius*, tuberculosis of the hip, ranks second in frequency to tuberculosis of the spine, or if we regard the spine as made up of a number of bones, then the hip-joint is more often affected with tuberculosis than any joint in the body.

Inasmuch as the entire hip-joint cannot be resected, or be obtained for examination until *post mortem*, it is not always possible to tell where the tuberculous process starts. Sometimes, after resection of the head of the femur, we find in it a sequestrum or some unmistakable sign of a primary focus, and we are accustomed to regard this bone as usually the primary seat of the affection, but doubtless the tuberculosis often starts in the acetabulum or in the synovial membrane.

In resections in adults we often find at operation one of two conditions, either the head of the femur more or less eaten away, lying in a collection of purulent material, and the acetabulum covered by velvety granulations, or the two bones eroded and tightly bound together by fibrous adhesions. Sometimes the acetabulum is largely eaten away, sometimes it is perforated by the tuberculous granulations, and the broken-down material finds its way in the shape of a cold abscess into the pelvis. More frequently the capsule yields anteriorly and below, and the abscess appears on the front of the thigh. As a rule, the head only of the femur is attacked, but the neck may also be involved.

Rarely the focus of disease is in the trochanter, and the process may never spread to the joint at all. In children the femur may be united to the pelvis by bony ankylosis. Often the spasm of the muscles crowds the head up against the upper border of the acetabulum and causes absorption of it and a change of shape—"wandering acetabulum." This displacement of the head upward accounts for some of the shortening characteristic of the disease. The rest is due to lack of growth in the bones, especially of the femur, and to destruction of the head. Rarely does actual dislocation take place. All the bones of the extremity show an atrophy, but this atrophy is most marked in the femur.

Symptomatology.

The three earliest symptoms of hip-joint disease are pain, stiffness, and limp. Sometimes one is most prominent, sometimes another.

The pain is felt in the hip itself, in the thigh, or often in the knee, and possesses the characteristics of the pain of joint disease, viz., it is worse on beginning of motion, and wears away by use, and it often comes on in an acute spasm at night. Later it is more or less constant. It is wont to cease entirely if the joint be immobilised, but during the formation of an abscess in the joint it is persistent.

The feeling of *stiffness* is akin to that of pain and is more apt to be noticed by older patients. At first it also disappears on using the limb.

The *limp* may be said to be the product of the pain and of the stiffness. Often much valuable time is lost in treating these symptoms as rheumatism.

On examination the first thing to attract one's attention is the limp. It is the limp of stiffness, not of weakness as in anterior poliomyelitis or in congenital dislocation. After the patient has been stripped a change of attitude may be noticed, sometimes in the early stages or after the rupture of an abscess through the capsule an attitude of extension, abduction, and outward rotation. More often the attitude more or less characteristic of this disease is flexion, adduction, and inward rotation. The recognition of the attitude of the limb and of the bearing it has on the physical signs is sometimes difficult to the uninitiated, and a few words may properly be said here as to the symptom-complex.

When the normal subject lies upon his back, his lumbar spine (usually in adults, always in children), his pelvis, his hips, and his lower extremities rest upon the table, and if his heels are near together, his extremities will roll somewhat outward, and his feet will be seen slightly to diverge. This is the normal posture of extension and of slight external rotation, indifferent as to abduction or adduction. Any deviation from the normal as to rotation can easily be distinguished by comparison with the well side.

If fixed flexion be present, the popliteal space leaves the table and the thigh is seen to be at an angle with the trunk; but it must be remembered that the lumbar spine is flexible, and if it arches upward the knee can be crowded down upon the table. Hence, in determining whether flexion is present one must always be sure that the lumbar spine is flat. If there be any difficulty in keeping the spine on the table, this difficulty may be overcome by flexing the sound thigh on

the abdomen, thus holding the back firmly down. If flexion be actually present on the affected side, the knee on that side cannot then be brought down to the table.

The attitudes of fixed abduction and adduction are not so easily understood. The matter is slightly confusing, but a little study clears it up. Normally in standing, lying, or walking the thighs are neither in abduction nor in adduction, but are parallel (Fig. 47; 1, *c, d*). Now, if we suppose that the left thigh is adducted (Fig. 47; 2, *d*), and that the pelvis (*b*) and the spine (*a*) are fixed and immovable, then the left thigh (*d*) will be crossed over the right thigh (*c*), and progression will

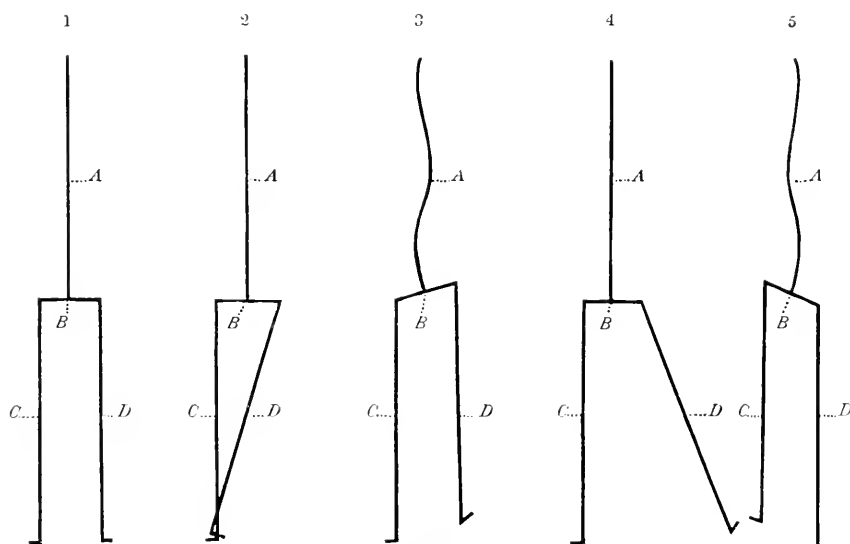


FIG. 47.

be extremely difficult; but the lumbar spine is flexible, and in order to bring the thighs into line, nature tilts the pelvis up on the affected side (Fig. 47; 3). At the same time, it will be seen that this manœuvre throws the sound thigh into abduction, and draws up the affected extremity, so that it looks to be shorter—*apparent shortening*—while a measurement shows that there is no real shortening.

An analogous state of affairs is present when the limb is in abduction (Fig. 47; 4 and 5).

The change in attitude of the limb is responsible for various physical signs that are often present; *e.g.*, if the thigh is flexed, the gluteal fold will be shorter and shallower and the fold of the groin deeper than

on the normal side. If the limb is in adduction the fold of the groin is deepened, if in abduction it is made shallower.

Limitation of motion will usually be present in all directions, varying from a slight limitation at extremes to a complete abolition of motion. Attempts at passive motion cause pain and muscular spasm.

Sensitiveness and sometimes swelling can often be observed over the head of the bone, and thickening about the trochanter. The practice of striking the soles of the feet in an attempt to elicit pain is unnecessary, and, as it inflicts trauma, it is to be condemned.

Atrophy of the thigh and of the calf can often be discerned by the naked eye, but should be accurately determined by the tape.

Measurement from the anterior-superior spine to the tip of the internal malleolus shows the extremities to be of the same length or very nearly so—within a quarter of an inch. Measurement from the umbilicus to the two internal malleoli reveals the apparent change in length; adduction causes “apparent” shortening, abduction “apparent” lengthening. The apparent shortening or lengthening, it may be remarked, is the practical shortening or lengthening; for if the extremity be drawn up, it is functionally short as well as apparently so, and the patient will always complain that his leg is short. The angle of deformity can be calculated from Lovett’s table, but it is not of great practical importance.

Differential Diagnosis.

What has already been said in the section on general differential diagnosis will be found to apply to the hip. There are two or three special lesions, however, that should be differentiated here; namely, congenital dislocation, coxa vara, and “chronic arthritis.”

In congenital dislocation the limp will have been present from infancy, the joint will not be painful except after prolonged exertion, muscular spasm and signs of inflammation will be absent, abduction only will be limited, the shortening will amount to an inch or more, and, finally, the head of the bone will be found both by palpation and by the x-ray to be out of its socket.

Coxa vara (bending of the neck of the femur) is a disease of adolescence, causing limp, limitation of motion and pain. The limb is in an attitude of adduction, extension, and outward rotation, while abduction, flexion, and internal rotation are limited. Actual shortening is present of about 1/2 inch to an inch, the trochanter is prominent,

and the *x*-ray shows that the angle of the neck and shaft is more acute than normal, and that the head of the bone is in its socket.

"The *hypertrophic type of chronic arthritis* has an insidious onset and many features in common with hip disease. It does not declare itself until a later period of life than is usual for tuberculous arthritis, but atrophy, shortening, limp, pain, and stiffness characterise the condition when it is well established. The limitation of motion which is characteristic of this process is not caused by muscular spasm but by mechanical obstruction, and this fact is readily recognised upon physical examination. Abduction and inward rotation are most restricted." (Goldthwait, Painter, and Osgood.)

Separation of the epiphysis, and fracture of the neck of the femur, "intracapsular," may sometimes be differentiated by the history and by the amount of shortening—greater in proportion to the duration of the symptoms than in hip disease—but often the Röntgen rays will be our only sure means of diagnosis. In these lesions, one will sometimes find that the symptoms were first noticed some time after the trauma, and that, contrary to what one would expect, the symptoms did not immediately supervene.

Conservative Treatment.

The first indication is to remove any existing deformity, and this may be done in one of several ways.

1. Rest in Bed, with Traction.—Two strips of moleskin plaster, provided at their lower ends with buckles, and reaching from the malleoli almost to the level of the perineum, are bandaged to the external and internal aspects of the extremity. An oblong piece of wood with a hole in the centre is then strapped to these buckles, and a rope is brought through the hole in the board and is knotted to keep it from slipping out. This rope passes over a pulley fastened to the foot of the bed and attaches to weights of 5 to 25 pounds. The foot of the bed is raised to give counterextension. In order that the traction may be made in the line of the deformity, the affected limb is flexed until the lumbar spine lies flat upon the bed, and then is supported by an inclined plane.

As the spasm gives way and the deformity lessens, the inclined plane is lowered until the limb rests upon the bed. The traction in bed may be preceded by the application of a hip-splint. In this case the traction is then applied to the lower end of the splint.

2. Slow Correction by Plaster-of-Paris Spicas.—With assistants holding the limb in the best possible position, a plaster spica, well

padded, is applied from axilla to toes. This plaster remains on for several weeks, and, when it is removed, the deformity will be found capable of partial reduction. Another spica is then applied in the improved position, and others follow it until the deformity has entirely disappeared. This is the method of Lorenz, somewhat tedious but safe.

3. Immediate reduction of the deformity under ether, followed by the application of plaster, or of a hip-splint, with succeeding rest in bed.



FIG. 48.—Hip-joint disease, cured by conservative treatment with function so good that the diseased joint could hardly be detected. It is on the left of the picture.

This method has its disadvantages, but if the deformity be reduced gently and if the reduction be accompanied by strong traction on the limb, little injury can possibly be done to the joint, especially if the deformity is caused almost exclusively by muscular spasm, which relaxes with the administration of the anæsthetic. In dispensary cases, without hospital facilities, correction under an anæsthetic is the only practical way, for rest in bed with traction or with long spicas cannot be used among the poorer classes. Whatever method we elect,

the position of the limb which we wish to obtain is slight abduction (about 20°) and full extension or very slight flexion. As the limb almost invariably tends to become flexed, it is well put up at first in complete extension.

After the reduction of the deformity, the conservative treatment of a tuberculous hip consists in rest for the joint until nature has cured the disease, meeting meanwhile any complications that may arise, and, according to the individual preference of the surgeon for immobilisation or for traction, he will rely mainly upon 1, plaster of Paris, or 2, braces.

1. The short plaster-of-Paris spica in the treatment of hip disease was first introduced by Lorenz about 1891, and has been gaining in

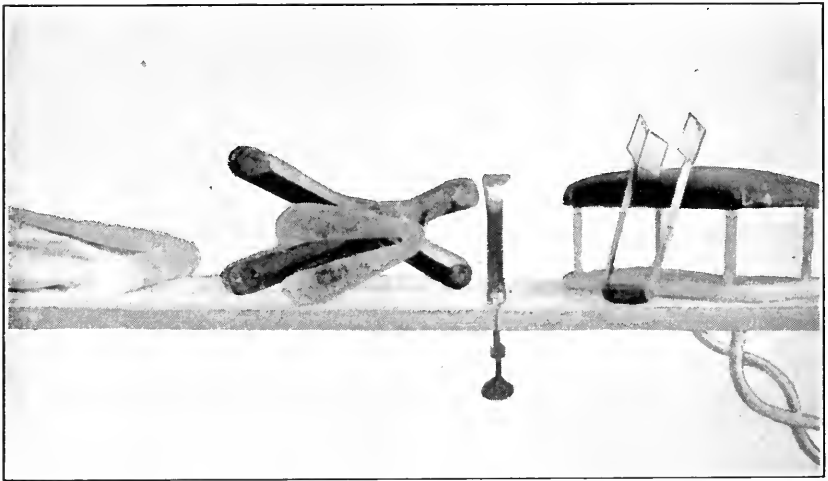


FIG. 49.—From left to right: Schultze pelvic rest, author's modification of the Lorenz pelvic rest, Lorenz stirrup, head and shoulder rest.

favour ever since. Until 1900 it was used in this country very little or not at all; now it is the routine treatment in many hospitals and clinics. It enables the patient to use the limb in walking, and so avoids the extreme atrophy that is apt to accompany the treatment by braces.

With the hip in plaster the patient can run about and play; and his general condition will be better than if he be hampered by a heavy and cumbersome brace. The spica is more comfortable and less troublesome than a brace and enjoys the other advantages enumerated in the general section.

On the other hand, the protection afforded to the joint by a well-

fitting brace is thought by some to be more thorough, and better functional results have been claimed for it. The claim has also been made that with its use abscesses are rarer. *If a skiagram shows a marked acetabular involvement a brace should decidedly be the choice.* On account of the thinness of the bone at the acetabulum, weight-bearing is contra-indicated.

With all the theoretical disadvantages of the spica, the fact that it has made such headway in America, the home of the traction brace, shows that it must possess decided merit, and those who have used it most seem unwilling to abandon it for a brace. If properly applied it will control the tendency to deformity better than almost any form of brace that has been devised, but to do this it must be well fitted and molded.

For the application of a spica two assistants are advisable, one to hold the head and shoulders on the shoulder rest, and the other to stand between the legs and hold them in position. The latter will give special attention to keeping the thigh on the side of disease in extension and abduction.

The stockinette shirting should reach from the nipples to the malleoli of the affected extremity, like a long pair of drawers with one leg cut off, and after the patient has been placed on the pelvic and shoulder rests, the bony prominences of the pelvis and of the knee should be well padded with sheet wadding or corn-plaster felt. It is not necessary to use any padding whatever over the muscles of the thigh. A snug bandage holds the padding in place.

The plaster bandages are then applied, reversed repeatedly and piled up over the pubes, so that the plaster there will be about an inch thick, while at the knee its thickness will not amount to more than about $1/4$ or $3/16$ inch. While it is being applied and afterward it is thoroughly rubbed and molded, especially about the pelvis, and then it is trimmed with a sharp knife in the following manner: Above at the side the line starts about 1 inch above the crest of the ilium, and sweeps down across the belly with its concavity upward, so as to lay bare the umbilicus, and then rises to the former level on the other side, and so straight across the back to the starting point.

Below, at the knee, the plaster holds the two condyles and the patella, and is cut with a concavity behind so as to allow flexion of the knee. Finally, a third cut starts from below the level of the trochanter on the well side, and, arching across just above the pubes, passes about 2 inches below the top of the inside of the affected thigh, and so under, upward and across, clearing the anus by about 2 inches, to the starting point.

After the superfluous padding has been trimmed away with a pair of bandage scissors, the shirting is turned up over the plaster and sewn together, so as to make a covering as well as a lining. "Scratch" bandages under the shirting will keep the skin in condition.

If one desires to relieve the hip of weight-bearing, one includes the



FIG. 50.—The Lorenz short spica.
A Sea Breeze case.



FIG. 51.—The Lorenz short spica. Note the calf development on the affected side, and the excellent condition of the children.

leg as well in the plaster, and in its lower part incorporates the bars of the Lorenz stirrup. In this case the sole of the shoe on the sound side should be raised 2 to 3 inches by cork or wood to compensate for the extra length. The same result may be obtained without the stirrup if the high shoe be worn on the sound side, and the patient use crutches.

If the joint be very sensitive, the plaster spica may be lengthened so as to include the lower part of the thorax above, and the foot below. With this spica locomotion will be practically impossible.

The Thomas hip-splint is designed to afford fixation, and not traction, and is therefore similar in its action to the plaster spica, though probably not nearly so efficient, and much more troublesome. It is not designed to permit weight-bearing, and the patient who wears it wears a high shoe on the sound side, and goes on crutches.

The traction brace consists essentially of a leather-covered steel pelvic band which partly encircles the pelvis just above the trochanters, and of a stem running downward from the external aspect of the pelvic band and at a slight angle with it, corresponding to the inclination of the pelvis, to a point 2 1/2 to 3 inches below the sole of the foot, where it is turned inward to form a foot plate. At the level of the knee the upright is provided with a band which encircles the knee and holds it in place.

The traction is exerted by means of long strips of mole-skin adhesive plaster on the inner and outer aspects of the thigh and leg, provided at their lower extremities with buckles. To the foot-piece are attached straps which fasten to the buckles. Counter-extension is provided by perineal bands, which buckle in front and behind to the pelvic band; in front, directly over the origin of the adductor muscles, behind, somewhat further out, so that the straps will pass over the tuberosities of the ischia. The foot-piece is usually shod with rubber or leather to prevent slipping. The perineal bands are made of stout webbing covered with two or three layers of canton flannel to prevent chafing.

Many modifications and varieties of the brace have been devised at one time or another. Sometimes the pelvic band is jointed to the upright, sometimes it is bolted fast. The upright may be provided with a rack and pinion for extension, perineal straps may be replaced by a leather-covered steel ring (Thomas ring), about the top of the thigh, or there may be but one perineal strap instead of two. Sometimes the pelvic band is rudimentary, sometimes the upright is provided with a "lateral traction" strap which is designed to pull the thigh outward.

The brace in use at the Boston Children's Hospital has no typical pelvic band nor perineal straps, but instead an incomplete ring about the top of the posterior portion of thigh, continued by a sort of U-shaped piece over the pubes on to the perineum of the sound side. With any form of traction brace the sole of the shoe on the well side should be raised 2 to 3 inches to compensate for the length of the brace.

It will be seen that none of these braces immobilises the hip-joint, and indeed the whole theory of the traction brace rests, as its originators claimed, on the idea of "motion without friction." They believed that immobilisation promoted ankylosis, and that a certain degree of motion was beneficial. Later this theory was modified somewhat and motion was regarded, while not actually beneficial, at least as harmless.

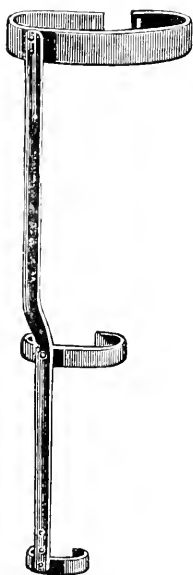


FIG. 52.—The frame of the Thomas hip splint.

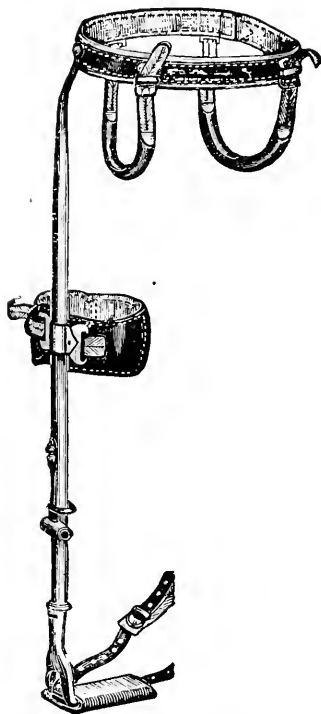


FIG. 53.—The ordinary traction hip splint.

That a properly fitted brace, one, that is, which allows motion, provides rest for a tuberculous hip there can be no doubt, for the pain often disappears as soon as it is applied, but whether this rest will not better be provided by immobilisation is a question which is still to be decided. The weight of opinion is strongly against the theory that immobilisation here or elsewhere ever causes ankylosis.

The traction brace does not provide steady traction. It acts more as a stilt. Every time the weight of the body is put on it the pull is relaxed. In the end it will be found that the apparatus derives its

good simply from rest, from deprivation of function. Relying on our knowledge of the pathology of joint tuberculosis we shall judge every form of appliance by its ability to deprive the joint of function. For those cases in which weight-bearing is contra-indicated, *e.g.*, for those with marked acetabular involvement, the traction brace is perhaps the most satisfactory appliance at our command.

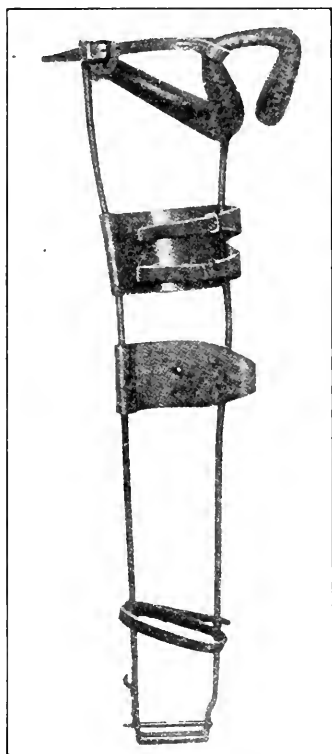


FIG. 54.—Hip splint in use at the Children's Hospital, Boston. (Courtesy of Dr. Bradford.)

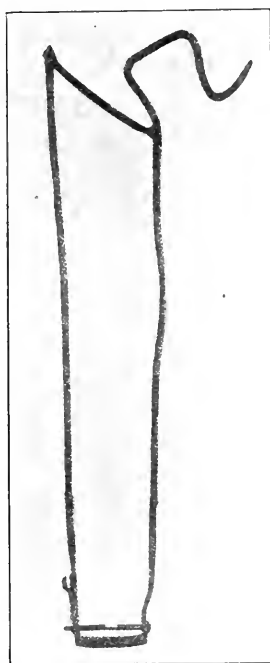


FIG. 55 —Unpadded frame of Children's Hospital hip splint.

Two methods of treatment have been devised to combine traction and immobilisation. In the first, the ordinary brace with pelvic band is provided with a thoracic extension, that is, with a bar that runs upward from the pelvic band as a continuation of the upright or stem, and that is provided at its upper extremity with a similar band encircling the thorax. The great objection to this brace is its weight, and its splinting the body to such an extent that locomotion is ex-

tremely difficult. In the other method a short plaster spica is applied under the ordinary brace.

The routine treatment recommended for hip-joint disease is, first, reduction of the deformity, and then ambulatory treatment by the plaster spica. The patient is permitted to go about as much as he wishes, but is not urged to use the hip at all. When a skiagram shows extensive involvement of the acetabulum, weight-bearing should not be permitted, and a short spica is out of place. If the hip be sensitive, the Lorenz stirrup may be incorporated in the plaster, or, better still, the patient may be put to bed with his spica on, or with traction.

If an abscess of any size is present, it should be aspirated, if necessary repeatedly, and its cavity should be injected with one of the iodoform mixtures or with Beck's paste, before the abscess approaches near enough to the surface to become secondarily infected. If discharging sinuses are present, a long brace with thoracic extension is substituted for the plaster, and the treatment is reinforced by bismuth paste injections, or by cupping.

In the case of an abscess in the joint which is causing great pain, a thin scalpel may be thrust in above the level of the trochanter, piercing the capsule and relieving the tension.

Extreme degrees of deformity following the disease can be corrected by an osteotomy, linear or wedge-shaped, at the level of the lesser trochanter, or by an osteotomy of the neck of the femur.¹

The most satisfactory operation in these old cases is probably the removal of a wedge of bone, with its apex at the lesser tuberosity, dividing with a chisel all except the innermost shell of the cortex of the femur. If much flexion be present, it is well to have the base of the wedge opening somewhat posteriorly, or to do a linear osteotomy.

The tendency in a cured hip is toward deformity in flexion and adduction. The weight of the body pushes the joint into flexion when the patient sits. Sometimes an osteotomy will be necessary years after the disease has been cured with the thigh in a good attitude.

The duration of hip-joint disease is from two to four years or more. The prognosis as to cure is favourable. As to motion no definite prognosis can ever be made in a child's joint. The result may vary from complete ankylosis up to good motion. If the tuberculous granulations have once really invaded the joint, and have damaged the cartilage, it is hard to see how perfect function will ever be attained.

¹ Vincent (*Revue de Chir.*, 1902, ii, p. 465) maintains that articular osteotomy and cervical osteotomy should not be done in tuberculous hips for fear of re-awakening the disease. Osteotomy followed by ankylosis in a good attitude causes a great amelioration in the condition of infirm "Coxalgiques," as much from a moral and æsthetic point of view as from a functional. Therefore, one should always suggest to a patient cured of hip-joint tuberculosis, but with his thigh in a vicious attitude, a rectifying osteotomy, with a practical certainty of good results.

In the case of an adult, the prognosis without operation is distinctly bad, with operation it is good.

Double Hip Disease.—The treatment is made more than doubly hard by this complication. Rest in bed with traction entails great difficulty in keeping the patient clean, on account of the adduction of both thighs. Treatment by traction splints is impracticable. All our efforts should be expended to maintain full extension, and abduction at an angle of about 20 degrees in each thigh. In case of final complete ankylosis, this is the best position not only for locomotion but also for purposes of cleanliness. The best method of treatment is by a short double spica. I have never seen double hip disease in an adult.

Hip Disease and Pott's Disease.—If the spinal lesion be low down, plaster of Paris may be applied from the axilla to the knee, but if the lesion be above the lumbar spine, recumbency and traction in a frame will probably be found the wisest course. A patient whose spine is immobilised by a brace or by a jacket will find locomotion in a traction hip splint very difficult, though occasionally this treatment may seem expedient.

A combination of disease of the hip and knee is very rare. If the two joints involved be on the same side, a long splint accurately fitted will suffice; if on opposite sides, a combination of plaster on the knee, and traction in recumbency on the hip should give the best results.

Operative Treatment.

In a child, with the exception of such operations as are necessary for straightening the limb and for correcting deformity, operative treatment is almost nil. Many cases present themselves in which the temptation to use the knife and sharp spoon is very great, but such interference rarely does any good and only serves to disseminate the disease. A small localised focus in the joint, with an uninfected, comparatively harmless abscess in communication with it can, by unwise, vigorous measures be easily converted into a large, foul, infiltrated, suppurating area.

It is a simple matter to insert a knife, let out the contents of an abscess, and "provide free drainage," and the authority and custom behind this treatment are strong, but it is an error. We may aspirate, inject, or possibly may make small incisions and cup after the manner of Klapp, but here as in other joints, with the exceptions noted above, the operative treatment in children consists exclusively of amputation.

We practise conservative treatment until all hope of saving the limb is gone, and then amputate it to save the child's life. No matter how bad the local appearance may be, so long as there is no prolonged,

severe constitutional involvement, no visceral complications, we may always hope for a useful limb.

On the other hand, if we resort to a resection, the prospect of a permanent cure is not a brilliant one, and even if a cure result, the interference with the growth of the upper epiphysis will cause great shortening and deformity.

In children one must never lose sight of this loss of growth when a radical operation is contemplated upon the epiphysis of the long bones. Most of the growth of the femur is at its lower epiphysis, but some of it is at the upper.

Another fact that should be mentioned is that resections of the hip-joint in children, done, as a rule, only in cases of advanced suppuration, have a mortality of about 50 per cent.¹

In adults the case stands absolutely different. As in other joints, so here conservative treatment is long, tedious, and unsatisfactory, doubly so in the hip because of the cumbrous nature of the apparatus. Conservative treatment should be tried, however, in ordinary cases for six months, not only to eliminate error but also in the hope, however faint, of obtaining a cure in this way. If, then, a distinct improvement be not evident, and if we be sure of our ground, we operate, not at random, but with a well-defined purpose.

We do not "open and drain" the joint, we do not curette, nor attempt the impossible task of eradicating all the tuberculous tissue by "tunneling" or by elaborate dissection. We set before ourselves a distinct idea, and follow it to its conclusion. *We deprive the joint of function, and avoid secondary infection.* This can best be done by a resection.

Many operations for resecting a hip have been devised, some aiming at an extensive removal of tuberculous tissue, some merely removing a greater or smaller amount of the head of the femur. It is quite evident that, no matter what may have been the idea in their authors' minds, none of these operations could possibly eradicate the diseased tissue. They must have achieved their purpose by destroying function. Enough of the bone was removed to produce dislocation, and with the stump of the head or neck slung by fibrous tissue upon the dorsum ilii, the joint as such ceased to exist (articulation par suspension, Ollier). Consequently in our resections of tuberculous hips we shall not attempt an impossible task, but shall simply lay hold of the vital principle—dislocation.²

¹ Townsend; quoted by Bradford and Lovett.

² The idea of curing tuberculous hips by producing a dislocation was advanced some years ago, but never received wide acceptance. Its efficacy in children is doubtful. I have been unable to find the original article.

The incision I use is one of about 6 inches in length, downward from the anterior-superior spine, through the skin and fascia. By a blunt dissection the incision is continued down to the capsule, going outside of the sartorius in order to avoid the branches of the anterior crural nerve. One then opens the capsule, gaining access to the joint, and, enlarging the opening, retracts the capsule, and reaches the head of the bone. The synovial membrane will appear thickened and inflamed. The cartilages may be badly eroded or they may appear almost normal.

Usually, in advanced cases one of two conditions will be found: the head, eroded, and denuded of its cartilage is adherent to the acetabulum, or, largely eaten away, and unattached to the acetabulum, it lies in a collection of pus. In either case it can be separated with a chisel from the neck. If it is attached to the acetabulum it may be loosened with chisel and gouge.

If one wishes, one may scrape the acetabulum. I have done it hitherto from force of habit. The wound may be washed out. When the retractors are withdrawn, the muscles fall together. One or two deep catgut sutures are inserted, and the wound is then sewn up with silkworm gut, without drainage.

To swab out with carbolic acid or iodine, or to pour in iodoform seems not only unnecessary and unscientific, but actually harmful.

After the application of a dry sterile bandage, the patient is raised upon a pelvic rest, and a plaster-of-Paris spica is applied from axilla to toes. An assistant holds the extremity in full extension, slight abduction, and indifferent rotation; that is, with the foot pointing forward. This position crowds the stump of the neck of the femur against the pelvis.

After two or three weeks the foot may be freed, and about 6 inches may be cut from the upper part of the plaster, liberating the ribs. At the end of about six weeks the spica is removed, the stitches are taken out, and a short spica is applied. In this the patient goes about, using crutches. The short spica is worn for two or three months longer.

The functional results of the operation are excellent. The 2 or 3 inches of shortening can be compensated by a high shoe, the thigh has a good range of motion, and the patient walks fairly well. For walking the result is probably not as good as an ankylosed hip, but for sitting it is much better. It is also easier for the patient to dress and undress.

This has been the usual result of an excision for a tuberculous hip—a dislocation upward, with a movable thigh. A bony anklyosis

has been difficult to secure, if not impossible. Recently Albee of New York has devised an extremely ingenious operation for producing bony ankylosis, and has used it with success in several cases of tuberculous hip-joint disease.¹ Through the anterior incision he opens the capsule of the joint, chisels off the upper portion of the acetabulum, ("that overhanging the femoral head," as the author puts it), and then the upper hemisphere of the head of the femur in a plane nearly parallel with the long axis of the neck. Next, as much of the cartilage as possible is removed from the acetabulum and from the head of the femur, the wound is sewn up, and a long plaster spica is applied with the thigh in slight flexion and well marked abduction. The resulting shortening is said to amount to not more than $\frac{1}{2}$ inch.

¹ Albee. Surgery, Gynecology and Obstetrics, March, 1910.

CHAPTER III.

THE KNEE.

Pathology.

The disease may start as a bony focus in the femur, in the tibia, or in the patella, or it may begin primarily in the synovial membrane, or in the fibula. The head of the tibia is considered to be the most frequent starting place. It is well not to be too positive about this.



FIG. 56.—Tuberculous knee in adult. About 10 years duration. Note disappearance of joint cartilage and the areas of rarefaction and condensation of the bone. These were demonstrated at operation. Fatty osteo-malacia was present to a marked degree.

Sometimes the primary focus can be detected with certainty, very often it can only be surmised.

The joint may be full of a serous, bloody, or purulent fluid, or it may contain no fluid at all. Sometimes the synovia is thickened and succulent, giving a boggy, doughy feel to the articulation. Again in

those slow cases with much production of fibrous tissue, little swelling or none at all is present, and the bones are bound tightly together by the adhesions.

In the cases with fluid in the joint, the patella floats; in the "boggy" cases it can be moved with a sort of soft resistance; in the fibrous cases it is bound tightly down to the femur.

In cases with a bony focus, before invasion of the joint, there may be a serous effusion. When the joint has been invaded the effusion is



FIG. 57.—Tuberculous knee, lateral view of preceding case. These skiagrams are more or less typical of a well advanced case of long standing.

sero-purulent or purulent, and in the cases characterised by much breaking down of tissue the whole joint cavity forms a tuberculous abscess.

The ends of the femur and tibia appear to be enlarged, but really the swelling exists in the circumarticular structures. This swelling in typical cases takes on a peculiar spindle shape, accentuated by the atrophy of the muscles of the thigh and calf, and the skin becomes blanched, giving to the knee an appearance from which the disease derived its former name of "tumor albus" or "white swelling."

The knee is held in slight flexion, and hence the strong flexors

work at an advantage over the large extensor, and the tibia is pulled backward on the femoral condyles, causing a subluxation. At the same time the tibia is rotated somewhat outward. In purely synovial cases this subluxation is not present.

Atrophy of the muscles of the thigh and calf is an early and constant phenomenon, especially in the bony type of the disease. The bones of the thigh and leg take part in the atrophy.

Symptoms.

The disease begins with pain in the knee, stiffness, and a feeling of discomfort. The pain is of the character usually experienced in tuberculous joints, as a rule worse in the morning, wearing off during the day, gradually increasing in severity. It is almost always much more severe in the bony type than in the synovial. This is true also of the muscular spasm and of the atrophy of the thigh and of the calf. The patient limps, and often walks upon his toes, with his knee flexed.

The joint is swollen and changed in contour. The swelling may be fluctuating or it may be boggy; the patella may float or it may not. In the late stages the mobility of the patella is almost always impaired.

Sensitiveness to pressure can usually be elicited over the bone ends, or, in the flexed knee, over the synovial membrane.

The joint is held in slight flexion and its range of extension and of flexion is limited and painful. This flexion in the later stages may reach an extreme degree, but in the synovial type is often absent for years.

As time goes on the swelling and œdema in and about the knee, and the atrophy of the muscles above and below the joint cause it to assume the classic spindle shape.

Sometimes the disease runs its entire course without the formation of an abscess. This is especially true in the type characterised by slow extension, with the production of much fibrous tissue. In other cases abscess formation is early. These are usually rapid in their course.

In children, in the early stages of the disease, the tape will often reveal a lengthening of the affected limb, caused by the stimulation of growth at the epiphyses of the knee. Later the limb will be shorter than its fellow.

Sometimes abscesses form and rupture, leaving sinuses which become infected. On account of the nearness of the joint to the surface, an abscess can rarely be restrained from rupturing after it has made its way through the capsule.

Prognosis.

The prognosis is distinctly good in disease of this joint, when it comes early under treatment. *Children* often recover with a fair degree of motion, sometimes with bony ankylosis. In *adults* we may not hope for anything but a stiff joint. Almost invariably any other result causes one to doubt the correctness of one's diagnosis. In adults the ankylosis is always fibrous. Bony union probably never takes place under conservative treatment.

The duration of the disease varies from one to two or three years. After conservative treatment relapses are liable to occur even in children. Some good authorities assert that the synovial forms in adults often recover with good function, but I am unable to confirm this statement.

Differential Diagnosis.

Chronic Joint Disease. Atrophic, infectious and hypertrophic forms. "These three types are most often polyarticular. The third should never cause confusion in diagnosis from tuberculosis. In it there is little if any capsular thickening, no increase of surface temperature, and usually more or less prominent and palpable osteophytic ridges about the femoral and tibial condyles or on the patella. Muscular spasm is rare in this type unless there has been a recent sprain. The first and second are capable of exclusion by the polyarticular character of the lesions. Occasionally there is a monarticular infectious arthritis, but its onset is usually more rapid than is the case in tuberculosis. The *x-ray* is of great service in separating these types from tuberculosis." (Goldthwait, Painter, and Osgood.)

Treatment of Tuberculous Knees in Children.

Conservative treatment is especially the treatment of choice in the knee until the patient has attained his growth, for it is in the epiphyses of the upper end of the tibia and of the lower end of the femur that more growth takes place than at any others, and any radical operation here before growth is complete will result in serious shortening. Except in very young children, the knee is one of the easiest joints in the body to control, either by a brace or by plaster of Paris.

If any fixed flexion with posterior subluxation have taken place great care must be exercised in correcting the deformity. Not only are the hamstring tendons contracted, but also the posterior and

lateral ligaments of the joint, and if the tibia be simply straightened by direct force, its head will be levered backward with the lateral ligaments as a sort of fulcrum, and the tibia will be brought into a parallel line with the femur, but on a plane posterior to it.

Various expedients have been proposed to obviate this difficulty. Whitman places the patient face downward on the table, and under ether forcibly extends the leg, but it is hard to see of what use this manœuvre can be. Billoth devised two lateral hinges with long iron

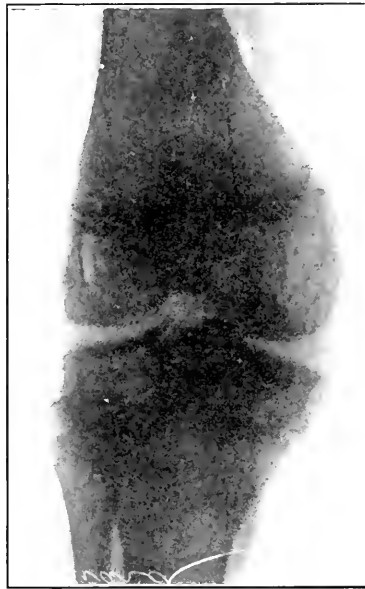


FIG. 58.—Tuberculous knee, antero-posterior view. Child about 10 years old, treated conservatively for about 3 years. Discharged cured from Sea Breeze Hospital, with a fair amount of motion

bars whose ends are provided with perforated pieces of tin for incorporation in plaster of Paris. The limb is put up in plaster, piled quite thick in the popliteal space. When the plaster has set, it is divided at the knee-joint and a wedge is driven in behind. From time to time the wedge is driven in further, until the leg is straightened. Several plaster dressings are used if necessary.

Sometimes the plaster may be applied rapidly, and then the upper part of the leg is pulled well forward while it is setting, in order to avoid the leverage action of the ligaments. This must be repeated several times in order to be effectual.

The patient may be put to bed with his leg in plaster, and then the leg may be put in a sling, and traction forward may be made upon its upper part by means of weight and pulley from the ceiling or from a high bar at the foot of the bed. The weight of the lower part of the leg and of the foot helps to lever the head of the tibia out from under the condyles of the femur.



FIG. 59.—Tuberculosis of the knee, lateral view of joint shown in Fig. 58.

No marked deformity at the knee should ever be rapidly and forcibly corrected, on account of the danger to which the contracted popliteal vessels are thereby exposed. Gangrene has been caused in this way.

After the reduction of the deformity, the surgeon will have a choice of plaster of Paris or of a brace. It is hard to say which is better. If plaster be used, the knee itself and the shin should be well padded, but not excessively. Over the snugly fitting encasement of shirting, a few layers of cotton wadding are placed about the knee, a few about the

leg at the level of the malleoli and at the top of the thigh, and one or two along the shin. The muscles of the thigh and of the calf need no padding. The plaster should be molded carefully about the knee and about the entire limb. At the knee it should be about $1\frac{1}{4}$ of an inch thick, but at the upper and lower ends not more than $1\frac{1}{8}$ inch. Above, it is carried as high as possible, and below to a point about 1 inch above the tip of the external malleolus.

The Thomas brace is the brace most used in this country in treating disease of the knee-joint. It consists of a padded, leather-covered steel ring, whose outline corresponds to that of a cross section of the upper part of the thigh, and of two steel rods running downward from the external and internal aspects of the ring. Below, these rods are joined by a rubber-shod steel sole-piece. Two broad leather bands are provided to support the back of the thigh and of the calf, and the knee is held securely in the brace by a bandage, or by another broad leather band which buckles over the front of the joint. Extension is provided by straps fastened below to the foot-piece and running upward to buckles attached to adhesive straps on the leg and thigh. The brace is made about 2 $\frac{1}{2}$ inches longer than the limb, and the sole of the shoe on the other foot is raised by the same amount to compensate for the extra length. In the later stages of the disease, when fixation only is required, the uprights are fastened below to the sole of the shoe, and the high shoe on the other side is abandoned.

The Campbell brace also is sometimes used in the late stages of knee-joint disease. It consists of a steel upright running on the external surface of the limb from the sole to the upper end of the thigh, with a free joint at the ankle. A second bar runs on the internal aspect of the limb from the top to the middle of the calf, and joins the other at its extremities by two curved, flat steel bars passing behind the thigh and calf. Two broad, stiff leather bands at the level of the cross bars encircle the thigh and calf, and are held by straps and buckles. A leather knee pad passes in front of the knee and fastens it securely in place. The lower extremity of the outside bar passes under the foot and is fastened by a steel plate to the sole of the shoe. In order to obtain a proper fit with this brace, a cast of the limb should be made, and the brace should be fashioned over this.

Probably the least unsightly appliance for the late stages of the disease is a plaster-of-Paris dressing that has been slit up, sprung off, baked in a moderate oven for twenty-four hours, and then has been provided with lacings. Any plaster dressing on the knee must be accurately fitted, for it has a tendency to sag, and to become uncomfortable.

When all active symptoms have subsided, and when the joint seems

to be well, whatever appliance the patient has worn should not be suddenly abandoned, but it should be left off at first during the night, and then by degrees during the day. If there be any tendency to deformity, or any return of active symptoms, continuous treatment should be resumed.

Tuberculous knees that have healed with bony ankylosis in a faulty position of flexion may be straightened by linear osteotomy, or, better still, by the removal of a wedge-shaped piece of bone with its base forward.

Operative treatment in children is limited to such small operations as may be necessary for cosmetic effect, for straightening the leg, or for the treatment of abscesses. Otherwise conservative treatment is consistently and faithfully carried out until constitutional involvement forbids its continuance. Then one resorts to amputation.

Various cutting operations have been recommended, especially that of synovectomy (so-called arthrectomy or erosion) but even these interfere so greatly with the growth of the limb and are followed by deformity so persistent that they have been generally abandoned.

In the case of *adolescents* conservative treatment is advisable until full growth has been attained or nearly so. If a cure be not attained by that time the treatment will be that of the adult knee.

Treatment of Adult Knee-joint Tuberculosis.

This is almost exclusively radical. Some good authorities state that the milder synovial forms recover under conservative treatment, with good function, and, while we may be disposed to question the correctness of this opinion, we are not sure enough of our ground to doubt the wisdom of an attempt to cure the disease in this way.

Our inability to make an invariably correct diagnosis will make us the more willing to give conservative measures a trial. We therefore apply plaster of Paris or an immobilising brace to the leg. If at the end of six months a marked improvement be not apparent, and if we have not changed our diagnosis, we shall do well to waste no time, but to resort forthwith to operation, for we know that we can cure the disease in this way without possibility of recurrence in about six months, whereas under conservative treatment we shall often need as many years and shall always fear a relapse. A stiff joint is the best we can get in either case.

The operation of synovectomy (arthrectomy, erosion), from which much was expected, has not justified the hopes of those who have practised it,¹ and it is now rarely done. It consists essentially of a dissec-

¹ Watson-Cheyne, *et al.*

tion of the synovial membrane with a scraping out of such diseased parts of the bone as are accessible. We have seen in our study of the general pathology and treatment why this procedure should not be successful. From "tunneling" operations also we may not expect much.

Excision is the operation usually performed in the knee-joint, and in disease of the knee-joint this operation finds its most striking results. As our theory is largely built up by observations on resected tuberculous knees, we may devote some time to a study of the *modus operandi* of the cure, perhaps repeating some things that we have discussed before.

Heretofore the best teaching has been that in resections we should "go wide of the disease" and should eradicate every particle of infected tissue. To one who will carefully study his joints in the laboratory this will immediately appear almost impossible. Yet resected knees almost invariably get well, provided they are not secondarily infected. Why is this? The knee is the one joint in the body in which a bony ankylosis is easily secured and it is the easiest joint to cure by resection. Is there any connection between these two facts? Some surgeons claim that the removal of a part of the disease gives nature a chance to "take care of the rest," but, if any motion remain in the joint, nature is unable to "take care" of any diseased tissue; and it must be remembered that nature has already shown her inability to take care of the original tubercle. We have seen that we cannot hope to eradicate all the diseased tissue, and yet the knee gets well if all function be removed. Why is this?

The answer "complete rest" is ready, but is no answer. Why does complete rest have the curative effect? If one removed most of a cancerous growth and then afforded complete rest to the part or organ no cure would result. It certainly must be the complete rest or deprivation of function that cures a resected knee, but in what way?

The synovia and the red marrow in the epiphyses of the femur and tibia, and in the patella, owe their presence here to function in the joint, and a study of our specimens teaches us that nature attempts to cure the disease by depriving the joint of function. In no case was this attempt of nature successful. When, however, the joint is deprived absolutely of function by a successful resection the synovia undergoes a fibrous change, and loses its peculiar structure, the spongy bone becomes dense bone, and the red marrow, yellow marrow. According to Ollier, Maclaure, and Lagrange,¹ a central medullary canal is often eventually established through the site of the former joint,

¹ Ollier. Diet. encycl. des sciences medicales, Paris, 1870. Ankylose, p. 191.
Maclaure. Nouveau Traité du Chirurgie, Paris, 1909. Ankyloses, p. 235.
Lagrange. Traité de Chirurgie, 1901.

and the femur and tibia become one long, hollow shaft. In other words, the joint is cured, not by eradicating every particle of infected tissue, but by an operation that will absolutely deprive it of function, and so cause a disappearance of the only two tissues that are vulnerable to the disease, namely the synovia and the red marrow. I have done a number of knee-joint resections, and in no instance have I ever practised the elaborate dissections of the synovia recommended by some authorities. Further, I doubt whether it is possible with any amount of care and of skill to remove all the diseased tissue—certainly it is impossible to tell with the naked eye, by the x-ray, or by any other means just how far the process has spread in the marrow—but an examination of the knee-joints removed by various operators and of the patients from whom the joints were taken, and a study of the histories convince me that the cures were effected simply by producing a firm, bony ankylosis, with the resulting changes in the synovia and in the bone marrow.

Two things were necessary for this, first, union of the wound by first intention, and, second, a fair resisting power on the part of the patient. In one or two instances the joint seemed overwhelmed by the disease, no bony union took place, and the resection was followed by an amputation.

If we accept this theory we shall discard all scraping and curetting operations as useless or worse, we shall abandon the custom of draining and packing, we shall choose in our resections the operation that is most quickly and easily done, and shall keep before our eyes only two objects—to secure primary union and bony ankylosis.

With these ideas in mind I have devised an operation that claims originality chiefly from the theory on which it is carried out.¹

We lay the joint open by a transverse incision, saw through the patella, dissect this out or leave it in, saw off about one-half inch from the condyles of the femur, chisel off the very tops of the tuberosities of the tibia, suture the lateral aponeurosis with catgut, and the skin with silk-worm gut, and put the leg up in complete extension in plaster of Paris. If drains are used they are to be removed in twenty-four hours. The crucial and lateral ligaments are not divided, hence no bone sutures, wire, or pegs are necessary. No attempt is made to dissect out the synovia, and iodoform, iodine, and carbolic acid are discarded as injurious. The operation is quickly and easily done, and sacrifices not more than three quarters of an inch of bone. It finds its greatest use in cases without secondary infection.

¹ Ely. Die Tuberkulose des erwachsenen Kniegelenks mit einer neuen Theorie und Operationsmethode, Berliner klin. Wochenschr., 1910, No. 45. Tuberculosis of the Adult Knee Joint, etc., Transaction of the Surgical Section of the A. M. A., 1910.

The incision in knee-joint resections as usually carried out may run above the patella, through it, or below it. The upper flap is retracted and the synovia in the pouch under the quadriceps is carefully dissected out. Then the knee is flexed, the crucial and lateral ligaments are divided, the ends of the bones are cleared and sawn off, every pocket of tuberculous tissue is cleaned out, and the dissection of the diseased synovia is completed. Some operators dust in iodoform, some swab with carbolic acid. Some use drainage, others do not. Bone sutures of strong catgut or of wire, bone pegs, ivory pegs, steel nails, all have their advocates. If it be necessary to fasten the bones directly together after a resection, then sutures or nails should be used; if not, then they are better left out. I am not alone in the belief that they are unnecessary. If a proper splint be applied, the bones will not slip on each other, and often the effect of sutures is illusory. They pull out very easily.

The pain for a few days after a knee-joint resection is often so severe that morphine must be used to control it. Possibly, if great care be taken to remove completely both semilunar cartilages, this severe pain can be avoided.

In the rare cases of a primary focus in the patella, the early removal of this bone has been advised. Röpke¹ urges an immediate operation, and affirms that after subperiosteal resection of the patella, its regeneration takes place. Care should be taken to spare the cartilage under the bone—rather a difficult undertaking. Theoretically, the operation should be useful if the joint have not been invaded.

Murphy² recommends that if the disease in the patella be not extensive, it should be cleaned out, and the cavity should be filled with a glyccero-gelatin-formalin plug. If the disease be more widespread, the patella should be removed.

¹ Wilhelm Röpke. Zur Kenntniss der Tuberculose u. Osteomyelitis der patella, *Archiv. f. klin. Chir.*, Bd. 73, S. 492.

² John B. Murphy. Tuberculosis of the Patella, *Surgery, Gynecology and Obstetrics*, March, 1908.

CHAPTER IV.

THE ANKLE AND TARSUS.

The Ankle.

Disease of the ankle is far less common than disease of the hip or of the knee. This of itself might be adduced as an argument against the traumatic origin of joint tuberculosis, for strains and wrenches of this joint are much more frequent than those of the hip, at least. Like tuberculous disease of the other small joints, the relative frequency of the disease in adults is greater than in children, as compared with the larger joints. As with other tuberculous joints the proportion of patients afflicted shows a slight majority in favour of the male sex, but here again the proportion is not great enough to correspond to the greater liability to injury in the male sex.

According to Sever,¹ out of 7474 cases of bone and joint tuberculosis in the Children's Hospital, Boston, only 213 were located in the ankle and tarsus. Of these the right ankle alone was involved in 108, the left ankle alone in ninety, and both ankles in fifteen.

Pathology.

The primary focus is found most often in the talus, but may occur in the tibia, in the fibula, or in the synovia. The disease may extend through the talus and thus may involve the other tarsal bones. Sometimes the talus, as well as the other bones of the tarsus, may be nothing but a large sequestrum.

As the talus is made up almost entirely of spongy bone, we can readily see how large a field this bone offers for the spread of the tuberculous granulations, and how easily the tarsal joints may become secondarily involved in primary ankle-joint disease.

The disease may spread through the talus and involve one of the tarsal synoviæ, and then may attack any of the tarsal bones or them all.

Abscess formation is the rule in disease at this locality, and because of the nearness of the joint to the surface, the abscess almost invariably becomes secondarily infected.

¹ Sever. Tuberculosis of the Ankle-joint and Tarsus, *Journal of the A. M. A.*, Dec. 17, 1910, vol. iv.

The condition of "fatty osteomalacia" is often beautifully seen in disease of the tarsal bones. They cut easily with the knife, and seem often to be little more than shells.

Symptomatology.

Pain, swelling, lameness, and atrophy of the muscles of the leg, are early symptoms, as are also muscular spasm, and limitation of motion. The normal contour of the ankle is obliterated, the hollows behind the malleoli and under and in front of them disappear, and the whole region becomes the seat of a diffuse swelling. The foot is usually held in equino-valgus, and the patient walks upon his toes, with bent knee. Sensitiveness to pressure is often quite marked, possibly more or less localised over the area of disease.

Differential Diagnosis.

A stiff, painful flat foot, by reason of its accompanying spasm, may at times be somewhat difficult to differentiate from tuberculosis of the ankle and tarsus, but the swelling and sensitiveness in flat foot are wont to be less in comparison with the stiffness and spasm, and what sensitiveness there is will usually be limited to the talo-navicular articulation. An *x*-ray plate will often be of great assistance, greater still if both feet be taken in the picture.

A "sprained ankle" will rarely cause confusion, because of its history. A skiagram here also will be of use.

Treatment.

Conservative treatment usually gives excellent results in children, even excellent functional results. It is very easy to carry out, and its duration is much shorter than in disease of the larger joints.

The joint should be immobilised by a plaster-of-Paris dressing, reaching from the bend of the knee to the toes, and should be put up in a position of right-angled flexion. If sinuses be present, windows may be cut out of the plaster at their points of opening.

If the patient walks upon this dressing, the impact of his foot with the ground will soon break the plaster to pieces, therefore we are compelled to adopt tilting in addition. This will best be done by the use of the Thomas brace, with a high shoe on the opposite foot. Inasmuch as extension by adhesive straps on the leg is impossible, the brace should be slung from the shoulders by straps which attach in front and behind to the thigh ring.

Cutting operations are rarely advisable in children.

Sever,¹ by comparing the results of conservative and of operative treatment in his 213 cases of disease of the ankle and tarsus in children, has concluded that conservative measures are preferable to operative. Eighty-eight cases were treated in this way.

Radical Treatment.

On account of the marked tendency to abscess formation and to extension to the tarsal joints in disease of the ankle-joint, operative measures should be undertaken in adults at the earliest possible opportunity, and here even less than in most other localities should one ever curette or attempt the futile operation of scraping and packing. To do so is to invite disaster, for if the disease once spread in an adult foot through the talus into the tarsal synovial cavities, an extensive resection or an amputation will almost always be necessary.

The most rational and probably the most satisfactory operation is ablation of the talus and removal of the cartilages of the bones with which it articulates, in order to secure firm ankylosis. The operation can well be done by a curved incision, convex below, starting above and behind the external malleolus, and running downward and forward to the anterior extremity of the talus. The peroneal tendons may be divided and later sutured. In disarticulating the bone, care must be taken to keep close to it on the inner side in order to avoid damage to the vessels which pass behind the internal malleolus. If the entire foot be subluxated backward, and if the sides of the calcaneus be freshened for apposition to the malleoli, the stability of the result will be increased, and a serviceable member will be secured—Whitman's operation.

If an abscess have ruptured, and if secondary infection have taken place, astragalectomy will probably not be efficacious. We shall hardly gain much by recourse to the usual conservative treatment by immobilisation, and any operation short of a wide resection or of an amputation offers little prospect of cure.

With this alternative staring us in the face, if the patient have the time to devote to it, a prolonged trial of Bier's hyperemia, combined with the suction cups, seems the most rational procedure, for it is in the smaller joints of the hands and feet that it is said to find its greatest usefulness.

Maass,² with Teutonic thoroughness, has published his observa-

¹ Sever. *Journal of the A. M. A.*, Dec. 17, 1910.

² Maass. *Die Tuberculose des Sprunggelenks*, *Archiv für klin. Chir.*, lxx, S. 182.

tions in 167 cases of tuberculosis of the ankle. They are so illuminating that they deserve to be quoted *in extenso*:

In 156 cases the treatment was operative, in eleven conservative. In seventy-six of the 156, bone foci were found; in fifty the bone was healthy or superficially diseased; in thirty the origin was doubtful.

In forty-five cases a focus was found in the talus—in eleven of these in other bones also; in twenty-two cases a focus was found in the tibia—eight times in other bones also; in eighteen cases a focus was found in the fibula—three times in other bones also.

Of the forty-five talus cases, sequestra were present in sixteen. Of these sixteen only three were in adults.

Of the talus cases, twenty-six of the foci were in the body, eight in the neck, five in the head, and six were unidentified. All the foci located in the body broke into the talo-tibial joint, except one that was walled in, and one that broke both into the "upper" and into the "lower" joint. The foci in the neck broke three times upward, and twice downward, once medial. In two cases the direction was not noted. The foci of the head all broke into the talo-navicular joint. In two children, five and six years old, the whole talus was a sequestrum.

Of the thirty-nine cases in which the consistency of the bones was noted, it was soft in twenty-three, hard in five, and soft and hard in eleven. Many had healthy cartilages.

The tendon sheaths were infected in seventeen cases, the dorsal tendon sheaths rarely.

In only two cases was the correct diagnosis not made before operation, but sixty-eight of the cases had fistulae.

The ankle-joint was affected alone in 53 1/2 per cent., with other joints in 46 1/2 per cent.

The operative treatment was as follows: 1, curetting; 2, arthrectomy; 3, partial resection with removal of foci; 4, typical resection; 5, amputation.

1. Curetting: this is to be done only when the patient refuses more radical measures. It was carried out in two cases that could not be followed long enough for the observation of results.

2. Arthrectomy was performed four times. The one adult patient went on crutches for two years and after that with a stick. The children, observed a few years afterward showed a marked interference in growth. All were cured; "Die Extirpation der Kapsel ist demnach in geeigneten Fällen als eine vollberechtigte Operation anzusehen."

3. (a) Extirpation of the capsule with removal of foci, six cases. Only two of these were successful, and they in children, with fairly good results.

3. (*b*) Removal of foci without opening joint, nine cases. In one case no bone disease could be found. Four cases were cured, three were not cured. In two the results were not known.

4. Resection, with and without astragalectomy, 102 cases. Langenbeck's operation was done fourteen times with six cures. "Aber auch diese Heilungen sind durch erhebliche Verkürzungen, fehlerhafte Stellungen, Schlottergelenke in der Art beeinträchtigt, dass nur einer von den Füßen als brauchbar im vollen Sinn angesehen werden kann."

König's operation, with and without astragalectomy, was done eighty-seven times: (*a*) with removal of the talus forty-one times, (*b*) without removal, forty-six times. (*a*) Eighteen of these recovered with a good foot, five with a fairly useful foot (fistulae, etc.), four died, twelve could not be traced; (*b*) five died after operation, in eleven a succeeding amputation was done, eleven were not traced. Of the remaining nineteen, two use their feet, but have fistulae, the others have useful feet.

The shortening in children's legs after these various operations runs up to a maximum of 13 cm!

Recovery: after plaster of Paris two, after arthrectomy ten, after Langenbeck's operation six, after König's operation forty-two. Total sixty.

Of fifty-four amputations, thirty-six were primary, eighteen secondary.

The Tarsus.

The joints of the tarsus may be primarily affected, or secondarily from the ankle-joint, especially if the primary focus be in the talus. Secondary infection with pus germs and abscess formation are the rule, and usually occur early.

Often much valuable time is wasted in treating the disease for rheumatism or for painful flat foot.

The significant point in tarsal disease, besides the spongy formation of the bones, is the extent and ramifications of the synovia. There are six or seven synovial cavities. The bones are bound together by ligaments running in every direction, and these again are covered by tendons, nerves, and blood vessels. To ascertain the exact extent of disease in these synoviae is a physical impossibility. To attempt to eradicate it with a curette, even if its extent were known, would be futile.

The symptoms and physical signs are much the same here as in tuberculous joints elsewhere. The patient usually walks on his heel,

with his foot abducted to remove it from strain. Two important diagnostic points in differentiating the affection from flat foot are the local sensitiveness to pressure, and the signs of inflammation over the affected bone or joint. A skiagram will show roughening of the bone and an irregularity of its contour.

Any of the tarsal bones may be the seat of the disease, and owing to their small size, joint involvement is apt soon to occur.

According to Hahn,¹ who has compiled statistics of 704 cases of tuberculous disease of the bones of the foot, the frequency of the dis-

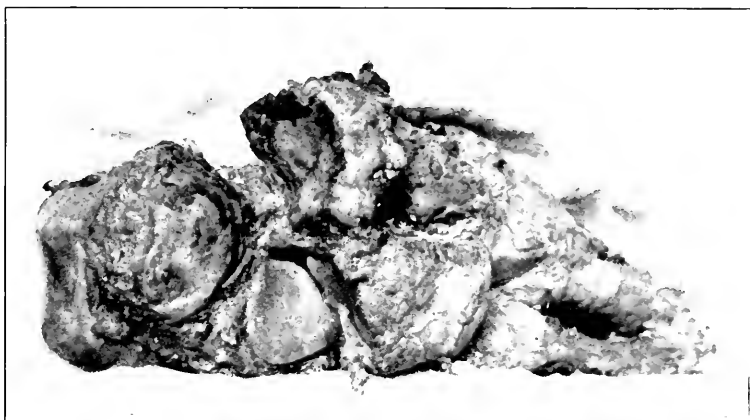


FIG. 60.—Tuberculosis of the tarsus. Talo-navicular joint laid open. Note erosion of articular cartilage.

ease diminishes as the distance of the affected joint from the ankle. The main determining factor is the amount of cancellous tissue in the bone.

A peculiar form of tuberculosis of the calcaneus occurs quite frequently in children, characterised by the formation of a sequestrum, with rupture of the disease toward the surface, and with little tendency to joint involvement, unless this involvement be brought about by unwise operative treatment.

Conservative Treatment.

In children, the treatment is almost invariably conservative. The reparative processes are vigorous, and a foot with discharging sinuses, which appears to be hopelessly diseased, under conservative treatment

¹ Hahn. Beiträge z. klin. Chir., Bd. xxvi, Heft. 2.

often recovers and forms a useful member. The temptation to operate is strong, but should be stoutly resisted.

In cases with secondary infection in which drainage is poor, and in which the patient suffers from septic absorption, the foot may be



FIG. 61.—Tuberculosis of the calcaneus.

immersed in a bath of salt solution at a temperature of 105°–110 °F. for an hour or two daily. This is a far better treatment than counter-incision and drainage, and one that will often give remarkable results. In the later stages we may use hyperemia.

The mechanical treatment is best carried out by the use of a

Thomas brace, and, if too many sinuses be not present, a plaster-of-Paris dressing in addition. As far as possible the foot should be held in a position of right-angled flexion to the leg.

If, on account of the sinuses, we are unable to apply plaster, we may be obliged to permit the foot to remain in a faulty attitude until the sinuses be healed. When they are healed the faulty attitude should gradually be corrected by plaster bandages.

An exception to this line of treatment is offered in disease of the calcaneus with sequestrum formation and without joint involvement. Here the utility of supporting apparatus is perhaps questionable, though possibly, if the calcaneus be deprived of its peculiar function, the amount of red marrow in it will diminish. One usually gets these cases after an abscess has opened and has become infected. Under these circumstances healing cannot be attained until the sequestrum has been removed. This should be done with as little damage as possible to the surrounding tissues. An unwise use of the curette will easily go through the shell of sound bone and cartilage, and will open a joint.

Bier's hyperemia has also been recommended here. It is certainly worth a trial.

Disease of the calcaneus is a most stubborn and tedious one to treat conservatively. I do not know that I have ever been able to follow a case through from start to finish, and I have a number of them in my clinical histories. Therefore, whether or not they can be cured by conservative measures I am unable to say of my own knowledge.

Finotti,¹ with a rich material of forty cases of tuberculosis of the calcaneus, has published the results of his work in a very interesting essay. He finds that the disease in this bone presents a number of peculiarities: 1. It has a tendency to remain localised, and only in advanced stages to spread to neighbouring bones and joints. This he regards as due to the isolated position of the bone. 2. The disease often spreads to adjacent tendon sheaths. This is on account of the close proximity of a number of the sheaths to the bone. 3. The disease occurs usually in one special part of the bone, and breaks through usually at one particular spot. 4. Sequestra are very often formed.

The disease is usually located in the anterior part of the bone, and breaks through on the outer side. The location is determined by the structure of the calcaneus. The anterior portion of the bone is spongy, with large meshes, *rich in marrow* (markweiche), and with few, delicate trabeculae, while the posterior portion is composed of denser bone,

¹Finotti. Deutsche Zeit. f. Chir., Bd. 40, No. xv.

with smaller meshes, and stronger trabeculae. The circulation is more sluggish in the anterior portion and the spongiosa is "markweiche." Hence the bacilli find a proper field.¹

As to prognosis, Pinotti says that the disease has a more favourable outlook than in other bones of the foot, after partial or complete resections. In children the treatment should be partial excision with following iodoform therapy. In adults the calcaneus should be extirpated. After its removal the ability to walk is not much diminished. If the tendon sheaths be very extensively affected, an amputation will probably be necessary.

Radical Treatment.

In adults, here as elsewhere the treatment is by operation. In cases with a bony focus, an early excision before joint involvement has taken place may effect a cure. (One of our specimens appears to have been a case of this kind.) Later this will be difficult or impossible.

In disease of the navicular there may be involvement of two joint cavities, one of them extensive and with a number of ramifications; in disease of the cuboid there may be involvement of three synovial cavities, and in disease of the talus or calcaneus of three. Naturally, when two or three bones are diseased, four, five, or six synovial cavities may be involved.

To cure the disease it will be necessary to destroy completely every ramification of the affected joint, that is, to deprive the joint of motion. Otherwise a steady progress of the disease may be expected in the portion not reached by the knife.

In the tarsus as in the wrist, to destroy the function is a practical impossibility, and we are driven to the other expedient of wide resections in order to get beyond the disease. In these two regions the principle of wide and thorough removal must be followed if we would attain a cure. If one is not absolutely certain that one can eradicate every bit of infected tissue, one amputates. The futility of the ordinary operation of curetting is especially manifest here, and if to this curetting a packing and draining of the joint be added, the spread of the disease will but be hastened.

In cases with extensive joint involvement, or in any case complicated by secondary infection, an amputation will often be found necessary, though Wolff has published excellent results from wide excisions of the tarsus.² The disease seems to run riot when it has once

¹ It is strange to see how near the author has come to what we consider the proper explanation.

² Oscar Wolff. Ueber ausgedehnte Resectionen am tuberculösen Fuss, Archiv für klin. Chir., iii, S. 304.

become diffused through the tarsus, and all temporising measures are useless, though possibly Bier's hyperemia may be of some avail, and may be tried if the patient's general condition warrant it.

"The good results which Bardenheuer has observed following extensive resections of the knee (frequently a third of the entire length of the leg was sacrificed in resections for tuberculosis) caused him to adopt the same conservative (sic!) measures in severe tuberculosis of the foot; that is, not primarily to amputate but to bring about a cure by a wide resection of all the diseased tissue.

"In resections of tuberculous joints the main thing is to remove every bit of diseased tissue. Only in this way can primary union and a complete cure be obtained. The incisions (*Resectionsschnitte*) must be only in healthy tissue. No consideration must be given to the diseased tendon sheaths, to the softened tendons, to the infiltrated muscles or to the periosteum. No attention must be paid to the amount of bone that must be sacrificed. When one operates on a tuberculous joint, one should thoroughly remove every particle of the disease, no matter where it lies." Oscar Wolff.

E. Ochse¹ has published the results in 115 cases of tarsal tuberculosis treated by operation in the Strassbourg Klinik between 1894 and 1906.

Spengler² reports 136 cases of tuberculosis of the ankle and tarsus, treated in Kocher's clinic. The disease started in the tibia in 20 per cent. of the osteal cases, in the fibula in 2.9 per cent., in the talus in 21.4 per cent., in the calcaneus in 14.3 per cent., in the navicular in 5.7 per cent., in the cuboid in 12.9 per cent. He recommends early excisions. If all the diseased tissue be removed at the operation, the chances of a cure are good; hence atypical resections are the rule.

Galzin³ secured a good functional result in disease of the internal cuneiform and first metatarsal, by removing the whole anterior and internal portion of the foot.

If any one point is settled in the operative treatment of a tuberculous tarsus, it is that half-way measures are absolutely useless, and are, on the contrary, harmful. No sight is more harrowing in operations on these joints than that of the surgeon blindly scraping with a curette, in the vain hope that a kind providence will guide his hand in the impossible attempt to eradicate a disease of whose extent he is entirely ignorant.

¹ E. Ochse. Ueber Dauererfolge bei Behandlung der Fusswurzeltuberculose durch Resektion mit vorderen und hinteren Querschnitt, Beiträge zur k. Chir., B. lvii. No. 2, S. 275.

² Spengler. Ueber Fussgelenk- und Fusswurzel-Tuberculose, Deut. Zeit. f. Chir., Bd. 44, No. 1.

³ Galzin. Revue de Chirurgie, 1905, p. 342.

CHAPTER V.

THE WRIST.

Disease of the wrist is very rare in childhood.¹ The primary focus may be in any of the bones entering into the formation of the joint, or possibly the involvement may be primarily synovial. The most frequent starting point is supposed to be in the head of the radius. Owing to the great extent of the synovial membrane of the lower part of the joint and to its many ramifications, tuberculous disease here, as in the tarsus, seems to be extremely difficult to eradicate. Abscesses



FIG. 62.—Tuberculosis of the carpus.

form early and break down, leaving sinuses behind. The tuberculous inflammation is especially liable to spread to the tendon sheaths passing over the joint, and the resulting tuberculous tenosynovitis adds severity to the symptoms of the disease.

The wrist is usually in slight flexion and pronation. Sensitiveness can be distinguished over the site of disease, and swelling and fluctuation and muscular atrophy are early. Motion of the joint is restricted in all directions, and is painful. The motion of the fingers is restricted from involvement of their tendon sheaths.

¹ Thirty-one out of 990 cases of tuberculous joints in children according to Karewski—Whitman.

Conservative Treatment.

Immobilisation is comparatively easy of attainment. The wrist should be put up in plaster of Paris, in slight superextension, and semi-pronation. The dressing may or may not include the fingers. It should extend up to the elbow. A splint of stiffened leather, laced up the front, may be substituted, and is somewhat more sightly than plaster.

Passive hyperæmia has its advocates in wrist-joint disease also, in fact in this joint it is supposed to be of especial advantage.



FIG. 63.—Tuberculousis of the carpus.

Conservative treatment in children offers a good prospect of cure with good function. In adults not much is to be hoped from immobilisation. Bier's treatment is said to give excellent results in adult cases. That it has a favourable action on the pain I believe from experience, though I have never been able to carry it through to the end, and to make up my mind as to its curative effect.

Briegel¹ gives the result of the treatment of thirty-four cases of tuberculosis of the carpus in the Tübingen clinic, by iodoform-oil injections. Twenty-four of the cases were completely cured, three were not cured, three required operative interference, seven died. The functional results were excellent.

¹ Briegel. *Beitrage z. klin. Chir.*, Bd. xx, Heft 1.

Operative Treatment.

If an excision of the wrist be attempted, it should be done early, and great care should be taken to obliterate the joint, with all its ramifications, in order to secure ankylosis. Otherwise the portion of the joint left behind will serve to spread the disease. One must bear in mind the anatomy of the wrist and must secure apposition of bare bone to bare bone. Often this will be difficult, sometimes impossible, and, after a series of bone scrapings and excisions, an amputation may be necessary. The involvement of the synovial cavities of the tendon sheaths adds difficulty to the problem.

In resections of the wrist it is manifestly impossible to eradicate all the synovial cavities with an idea of producing an ankylosis, if the bones be left in. If the disease be taken early enough, and if it be located entirely in one bone without synovial involvement, a simple removal of this bone should effect a cure. If a synovial cavity have been invaded, the only rational operation is an extensive resection. This may be practised in the wrist to good advantage, and if done thoroughly should cure the disease.¹

¹ "One can easily understand from a study of the anatomic structure of the wrist with its many small communicating joints packed in a small space, why tuberculosis even in its early stage seldom remains localised in small portions of the carpus. The joint clefts open the door to a spread of the disease. Hence the early involvement of the entire wrist in tuberculosis. Accordingly partial resections are rarely successful. Recurrences are frequent and compel further operative measures. If one operate on a tuberculous wrist one should, as a rule, remove all the carpal bones." Bardenheuer obtained useful ankylosed wrists by these methods in every one of eleven cases." (Oscar Wolff. Zur Resection des tuberculösen Handgelenks, Archiv f. klin. Chir. liii, 8, 313.)

CHAPTER VI.
THE SHOULDER.

Pathology.

Tuberculous disease of this joint is also quite rare, especially in childhood.

In general, two forms of the disease are recognised; the one, in which there is a production of soft tuberculous granulation tissue, with



FIG. 64.—Tuberculous shoulder. Patient 7 years old. (Courtesy of Dr. McCartney.)

formation of abscesses, and the other, in which the granulation tissue eats away, as it were, the head of the humerus, and destroys it without abscesses, the so-called "Caries Sicca".

The primary focus is said to occur usually in the head of the humerus. This was the case in both our specimens.

Atrophy of the muscles about the joint is early, and is especially marked in the cases of *caries sicca*.

Symptoms.

Pain is an early symptom, felt in the shoulder and running down the arm. *Limitation of motion* is present, but owing to the mobility



FIG. 65.—Tuberculous shoulder. Same patient as Fig. 64, two years later. Treatment by vaccines.

of the shoulder girdle on the sterno-clavicular joint, the limitation may escape the notice of the patient for some time. In testing for it, the shoulder girdle should be held fast by one hand while the humerus is moved about with the other.

Sensitiveness to pressure is quite marked. Fluctuation sometimes may be detected. Abscesses appear at the side of the deltoid muscle and, if untreated, rupture and give rise to sinuses. Atrophy of the muscles about the joint is extreme in the dry type, and gives to the

shape of the shoulder a peculiar flattening. The roundness of the deltoid disappears and is replaced by a more angular contour.

Differential Diagnosis.

A condition with which tuberculosis may readily be confounded is Duplay's bursitis (sub-acromial, or sub-deltoid bursitis). Here the



FIG. 66.—Tuberculosis of shoulder. Boy about 11 years old.

main restriction to motion is in abduction and external rotation, and the arm is held rotated inward. Often a history of injury immediately antedating the onset of the symptoms may be obtained. Sometimes the diagnosis cannot be made without the *x-ray*.

Treatment.

In children immobilisation gives the best results: The arm should be bandaged to the side, with the forearm suspended from the neck

by a sling. The clothes should be worn over the dressing. Later on, a brace may be worn which permits rotation but restricts other motions.

The author's brace¹ consists of a band of canvas or leather, about 3 inches in width, encircling the chest at the level of the nipples, and another slightly narrower about the arm. These are connected by two flat steel rods which arch upward and have at their extremities steel plates about 2 by 4 inches to prevent wrinkling of the bands. The band about the chest is held in place by narrow strips of canvas that fasten in front and back, and pass over the shoulder.

This brace allows rotation, which appears to be the least harmful motion in the joint.

The ordinary shoulder cap of felt or of plaster of Paris is of little use in immobilising the joint.

In adults radical treatment is best carried out by an excision. It can be done subperiosteally. The usual result is an ankylosed joint, quite useful on account of the mobility of the shoulder girdle at the sterno-clavicular joint.

¹ Medical News, July 23, 1904.

CHAPTER VII.

THE ELBOW.

Pathology.

The disease, if of bony origin, is said to begin most often in the ulna, less often in the humerus, and least often in the head of the radius. Primary synovial disease is fairly common. In one of our specimens the only tuberculous lesion discovered was a small bunch of granulations sprouting through the articular cartilage of the radius.

Abscesses are frequent in tuberculous disease of the elbow, and when they form can with difficulty be kept from rupturing.

Symptoms.

The usual symptoms of joint tuberculosis are found in disease of this joint. The *pain* is felt in the elbow, and perhaps shoots down the forearm. *Swelling* is an early symptom, and is diffuse. If fluid be present it is most manifest posteriorly at the sides of the triceps tendon. The muscles of the arm and forearm soon shrink, and this atrophy, with the swelling of the joint, causes the characteristic spindle shape of the elbow. The forearm is slightly flexed and midway between pronation and supination. Often flexion and extension are greatly limited, while pronation and supination are free. Usually all motions in the elbow are restricted.

In young children the disease is sometimes mistaken for fracture, but in fracture the sensitiveness is more localised, the swelling comes on more rapidly and subsides more quickly, and the resulting stiffness is painless, and can be seen to be due to mechanical obstruction rather than to muscular spasm. A good skiagram, when it can be obtained, may clear up the case.

Treatment.

In *children conservative treatment* is easy to carry out. The joint should be put up in plaster of Paris, in flexion at a right angle or slightly beyond, and should be kept there until it is well. In order to get the elbow into this position, if it be fixed in extension, ether or gas should be administered, or the method of Thomas may be adopted.

Thomas slung the wrist to the patient's neck, pulling the sling tightly

enough to make him bend his neck down toward his hand. As the position is uncomfortable, the patient gradually straightens up his head, flexing his elbow to that extent. This process is repeated daily until the required flexion has been obtained.

If sinuses be present windows may be cut in the plaster. Carrying the plaster bandage repeatedly up and down the extensor surface of the arm and forearm prevents its piling up in the flexor surface where



FIG. 67.—Tuberculous elbow. Child 7 years old. X-ray taken at the start of the process. This is the elbow of the patient whose shoulder is shown in Figs. 64 and 65.

it is not needed. The dressing should reach from the axilla to the wrist, or, in case of extreme sensitiveness, it may include the hand also. This treatment gives better fixation than any other. A sling will often be found useful in addition.

Radical Treatment.

In *adults* radical treatment probably gives the best results. The excision is performed sub-periosteally, in order to avoid division of

tendons. It may be done through a long posterior incision, through two posterior incisions, through Ollier's Z-shaped incision, or through Kocher's incision. The usual outcome is an elbow with a good range of motion, fairly useful as to its function, especially if the joint be put up immediately after the operation in the usual way, that is in right-angle flexion.

An elbow ankylosed at a right angle gives a fair functional result, and some operators state that if the joint be put up in full extension at



FIG. 68.—Tuberculous elbow. Patient 9 years old. Same joint as Fig. 67, two years later.

the time of operation, and after being in this attitude for a week or so, or until the wound be healed, if it then be put up in flexion, a bony ankylosis can be obtained. Under no circumstances should a bony ankylosis be permitted in extension, for in this position the arm is almost useless.

I have never had the opportunity to examine in the laboratory a specimen of a cured tuberculous flail elbow. It would be interesting to find out whether the existence of a true joint here disputes our theory of cure, or whether as in the ordinary cured tuberculous hip, there is really no joint at all and the bones are simply tied together by fibrous

tissue. There is so much surmise put down as facts that the truth is hard to ascertain.

Whatever operation be done, care should be taken to remove no more bone than is absolutely necessary and to work as far as possible subperiosteally. Lossen laid down the rule that the danger of a flail joint was increased with the amount of bone removed, especially when the resection was not a subperiosteal one.¹

Oschmann has done a great deal of operative work on tuberculous elbows, and his results and conclusions are well worth quoting.²

His material consisted of forty resected joints. At first he used Ollier's method, later Kocher's, which spares the nerve to the anconeus muscle. Of his patients fourteen died (35 per cent.). In none of these was death chargeable to the operation. Of the remaining twenty-six cases the end results showed twenty-five "scarred over and painless" and one fistulous. Six per cent. of the elbows were luxated or subluxated, 5 per cent. had a flail joint. Of twenty-five cases, in which the amount of motion was noted, in sixteen the hand and arm were useful for all sorts of work (64 per cent.), and in nine they were useful for light work. None of the patients had a useless limb. Flexion and extension were normal or almost so in thirteen cases, and were under ninety degrees in seven cases. Three were ankylosed.

According to Oschmann a good, useful, movable elbow is not only possible but is also the rule, and to strive for an ankylosis is an anachronism. Strict asepsis and early passive motion will help to prevent ankylosis; but, on the other hand, too early passive motion, unless an apparatus be used, even where there is an "excellent newly built joint," will produce a flail elbow.

Oschmann recommends the use of apparatus as a routine measure for a long while after all resections.³ This is jointed at the elbow, and permits motion through a restricted arc, preventing luxation and flail elbow. It holds the bones in apposition and allows them to become tightly united by connective tissue.

Reiner⁴ has resected five tuberculous elbows, doing the operation of Helferich, that is, with the interposition of a muscle flap. All recovered with good motion.

¹ *Handbuch der allgemeinen und speciellen Chirurgie von Pitha und Biliroth. Stuttgart, Ferdinand Enke., 1882, S. 258.*

² Oschmann. *Archiv f. klin. Chir.*, ix, S. 177 and 397. *Ueber die operative Behandlung des tuberculösen Ellenbogengelenks.*

³ Das Tragen des Apparats ist obligatorisch nicht nur in den Fällen, wo wir schon ein lockeres Gelenk haben, sondern auch überhaupt in allen Fällen nach der Resection des Ellenbogens, wenn wir eine gute Function des Armes erreichen wollen.

⁴ Hans Reiner. *Ueber die funktionellen Resultate der Resection des Ellenbogengelenks mit Interposition eines Muskellappens nach Helferich.* *Deutsche Zeitschrift f. Chirurgie*, Bd. civ, S. 209.

CHAPTER VIII.

THE SACRO-ILIAC JOINT.

Tuberculous disease of this joint is very rare, doubly rare in children. The male sex is said to claim a small majority of the patients, and among women the affection is especially apt to occur during pregnancy. All these facts seem to point to the causal relation of function to the disease.

Pathology.

The exact pathology is hard to ascertain. Owing to the difficulty of securing good specimens most authors are rather hazy on the subject, and I have as yet been unable to procure a specimen for study.

The synovia of the joint is comparatively small in extent, but the great masses of cancellous bone on either side of it afford the disease a good field for extension. The ligaments above and below are strong and thick, but those in front and back are thinner, and through these the abscess (which is very frequent here) may find its way anteriorly into the pelvis or posteriorly over the joint, or both anteriorly and posteriorly. Of fifty-nine abscesses tabulated by Van Hook¹ twenty-one, or 35.2 per cent., were extra-pelvic and thirty-eight, or 64.8 per cent., were intra-pelvic. Van Hook points out that the intra-pelvic abscesses may pass along the psoas muscle, upward to the lumbar region or downward to lie in the muscle sheath, or to a point near the insertion of the muscle. Or again these abscesses may emerge from the sciatic foramen and may appear in the buttock or on the back of the thigh.

Secondary infection seems to be the rule, and when it occurs the tuberculous granulations have a free field in the sacrum and in the ilium, giving rise to many burrowing sinuses and to marked constitutional involvement.

Symptomatology.

Pain is usually the first symptom of which the patient complains. The pain is perhaps localised at the seat of the disease, perhaps is felt

¹ Van Hook. *Annals of Surgery*, 1888, vol. viii, p. 407; 1889, vol. ix, p. 35 and 115.

in the buttock or shooting down the lower extremity. On account of the proximity of the sciatic nerve, the pain may manifest itself as a severe sciatica, and it is apt to be increased on motion, that is, by walking, by coughing or by sneezing. The pain can well be brought out by pressure upon the wings of the ilia, or by flexion of the thigh on the trunk while the leg is held in extension.

On account of the pain, the patient stands with his weight thrown over on the sound leg, giving a lateral curve to his spine.

Swelling, on account of the nearness of the joint to the surface, appears rather early. Local sensitiveness to pressure can be elicited on the surface, or by pressure through the rectum or vagina. The fluctuation of an abscess is felt in either one of these places or in both.

The prognosis is distinctly bad. Owing to the superficial situation of the disease, the abscess is extremely liable to early infection, and infection here usually means death. There is almost no limit to the extension of the disease through the pelvic bones, and the sinuses burrow in every direction.

Treatment.

The treatment is eminently unsatisfactory, and in most text-books is passed over rather cursorily, and necessarily so. One sees so few cases, even in a large clinical experience, that one hardly has a chance to formulate any well-defined treatment.

Whitman recommends for conservative measures a plaster spica, or a double Thomas hip-splint, combined with crutches, or a "broad, strong pelvic girdle which may be drawn tightly about the pelvis."

A spica may be used, continued high enough on the trunk to immobilise the lower lumbar spine. Crutches will be of greater service if a high shoe be worn on the well side, so that the patient cannot put the affected limb to the floor. A broad adhesive strap tight about the pelvis should relieve the pain.

Whatever means be adopted, weight-bearing should not be permitted.

All authorities seem to agree that abscess is an indication for extensive operations, but before this is done, one should certainly try aspiration and injection. Here, as elsewhere, to operate in the face of an abscess is to invite secondary infection, unless primary union can be secured. Theoretically it should be far preferable to assume in an adult that abscess is almost inevitable, and, as soon as the diagnosis be made, to do an operation with the sole idea of obliterating the joint. I say this with some hesitation, for I have not had the opportunity to carry out the idea.

CHAPTER IX.

THE FINGERS AND TOES.

Pathology.

Tuberculosis of the bones and joints of the fingers and of the toes, spina ventosa, tuberculous dactylitis, presents some features that distinguish it from disease elsewhere in the skeleton. The cases may be divided into two classes, those in which the joints are affected, and those in which the shafts of the bones are involved. To these latter the term "spina ventosa" should be limited. Spina ventosa is the form usually found in children and is quite frequent. Among adults the disease, as a rule, exists in the joints and is rather rare.

One of our specimens, an amputated finger of an adult, shows far advanced synovial disease, with an extension to the bone (Fig. 1). It was evidently a primary synovial case. The synovia hangs in long streamers like moss from a tree. The patient died of pulmonary tuberculosis shortly after the operation.

Another specimen represents tuberculosis of the metatarsophalangeal articulation of the great toe, also in an adult (Fig. 69). Its origin is impossible to determine, though the bone is badly involved. The treatment in this case was excision, followed in the course of about a year by a cure.

The structure of the bones entering into the articulations of the fingers and toes of an adult is that of the long bones generally, namely, cancellous bone in the epiphyses, and dense bone with a medullary canal in the shafts. The disease, therefore, has no tendency, if uncomplicated, to spread from one joint through the yellow marrow of the shaft to another.

Among children the usual form of the disease seems to be a myelitis which involves the shafts, the so-called spina ventosa. This seems to have little tendency to attack the joints. While the tuberculous process is advancing in the interior of the bone and is eating away its substance, the periosteum is said to lay down new bone on the outside, giving to the finger or toe its peculiar, enlarged, thickened, flask-shaped

appearance.¹ This reaction of the periosteum is denied by some observers, who base their contention upon *x*-ray findings.

Both types have a marked tendency to break down early, and to form an abscess with resulting sinuses.



FIG. 69.—Tuberculosis of metatarso-phalangeal joint of great toe.

In *spina ventosa* a probe may be passed down through the sinuses into the tuberculous bone cavity. This form of the disease often affects several bones, though not on the same finger, and the multiple lesions distinguish it again from bone tuberculosis elsewhere. In fact,

¹ "An den Phalangen der Finger und Zehen tritt die Tuberculose gewöhnlich auf als tuberculöse Osteomyelitis mit flaschenförmiger aufreibung der Knochen (*spina ventosa*). Hier wird die Knochenrinde in Folge der tuberculösen Osteomyelitis immer dünner während gleichzeitig in Folge reactiver Periostitis Osteophytenbildung auftritt. Die *Spina ventosa* heilt oft ohne Aufbruch, ohne Necrose mit vollständiger *restitutio ad integrum* spontan aus." (Tillmanns, Lehrbuch der all. Chir.)

these multiple lesions have given rise in many of the cases to a strong suspicion of syphilis, a suspicion strengthened by the productive inflammation of the cortical bone.

The opinion is held by some that the chronic inflammatory affections of the fingers and of the toes may be divided into two classes,



FIG. 70.—Tuberculosis of the phalanx in a child. This patient had also a suppurating process in the head of his tibia, with sequestrum formation.

those of the joints and ends of the bones, which are tuberculous, and those of the shafts, which are syphilitic; but this view, I think, is erroneous. I believe that syphilitic disease of the shafts of the phalanges is rare, while tuberculosis is rather common.

Symptoms.

In the tuberculous *joints* of the fingers and toes, these are such as might be expected—pain, sensitiveness, swelling, etc. The tendency to break down early, as has been said, is quite marked.

In the cases of spina ventosa, a swelling of one of the shafts of the small bones, with or without pain and sensitiveness, is the first thing noticed. The neighbouring joint may or may not be involved. This swelling may exist for a long time and may occasion little discomfort or disability. On the other hand, the swelling may increase, symptoms of secondary infection may supervene, and an abscess may form, which ruptures and discharges for a longer or shorter time through one sinus or through several.

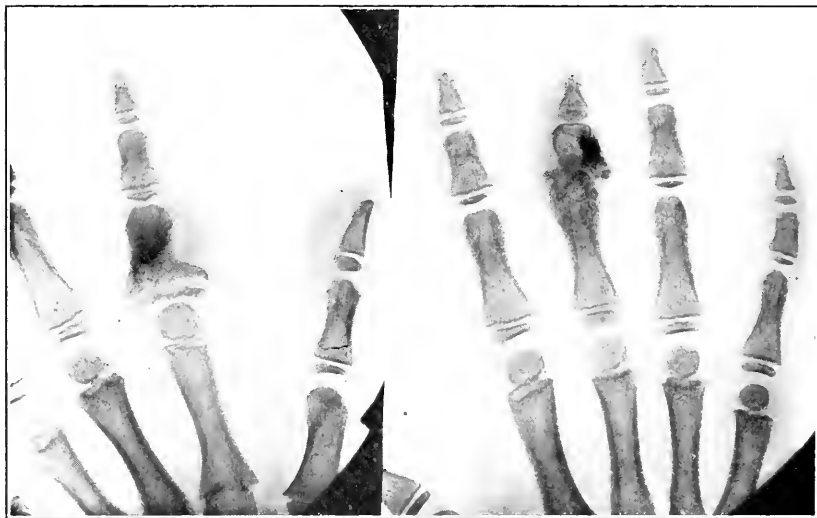


FIG. 71.—Dactylitis in boy of about 9 years. He had a distinct history of a syphilitic parent, but the lesions did not heal up under anti-syphilitic treatment.

Differential Diagnosis.

Tuberculosis of the phalangeal joints in adults might possibly be mistaken for arthritis deformans, but this disease is polyarticular when it occurs here, and the swellings and distortions are characterised more by ankylosis than by inflammation, and there is not the same steady progression, nor the tendency to break down. Acute exacerbations are the rule in arthritis deformans.

Gout may affect a single joint, usually, of course, that of the great toe. When seen for the first time its recognition may be difficult. Its acute exacerbations, its periods of quiescence, and the complete absence of suppuration will make its nature clear.

In a case of dactylitis (spina ventosa) the question immediately arises whether it is of syphilitic or of tuberculous origin, and this ques-

tion may be a difficult one to decide, especially in a closed case. Possibly unmistakable signs elsewhere of congenital syphilis may give us a clue, or the Wassermann reaction, or the trial of anti-syphilitic treatment. In an open case, the demonstration of the spirocheta pallida or of tubercles may solve the problem, or here also the trial of mercury and the iodides; but I have in mind the case of two brothers, sons of a probably syphilitic father, in whom after years of treatment



FIG. 72.—Dactylitis. The patient was a brother of the preceding patient.

and after several operations by three or four different men, with examination of tissue under the microscope, also by two or three men, the question was never decided. Mercurial ointment sometimes seems to benefit tuberculous cases.

Ware¹ and others maintain that in syphilis the epiphyseal ends of the diaphysis (not the epiphyses) are enlarged and translucent, and that the periosteum is very much thickened; while in tuberculosis

¹ Ware. *Annals of Surgery*, August, 1907.

there is never any periosteal reaction, the soft parts are more involved, and the cortical portion of the bone is never of that density peculiar to syphilis.

Prognosis.

The prognosis in tuberculous dactylitis is good. Under conservative treatment most of the cases in children recover with good function, provided their joints have not been damaged by injudicious operative treatment.

Treatment.

Conservative measures will be found best in children, radical in adults.

Conservative treatment consists of cleanliness, dry dressings, and the use of Klapp's suction apparatus.

Operative Treatment.

A very ingenious operation has been devised for the tuberculous dactylitis of children, consisting of a sub-periosteal resection of the shaft of the bone, and a careful dissection of the sinuses. The wound is then sewn up tight, with the purpose of securing primary union, and the finger is put up in plaster of Paris. As a matter of fact, primary union is easy to secure thus, and the impression one gets when the plaster is removed after a couple of weeks is that the disease is cured; but as soon as the bone re-forms (with its red marrow) the process breaks out afresh.

Two patients of mine, of about seven years of age, the brothers mentioned above, had this operation done on four fingers. I did it once and two others operated on the other three fingers. The wounds broke down later and nothing was gained. Another of my patients, a child of about three years, had a spina ventosa on each hand. At my request an enthusiast on this operation performed it on one finger. The other finger, treated conservatively with the suction apparatus, showed far better progress after the lapse of some months.

Stubenrauch¹ excised the tuberculous first phalanx of the left middle finger, whose extensor tendon had been destroyed, dissecting out its sinuses also, and transplanted the first phalanx of the third toe with a piece of the extensor tendon, 7 cm. long. Six weeks after the

¹ Stubenrauch. Spina ventosa, Münch. med. Woch., 1909, 36.

operation the child could move the finger well. The *x*-ray showed no change in structure of the transplanted phalanx.

Ahrens¹ has shown a case of spina ventosa in which the metacarpal bone of the thumb, destroyed by tuberculosis, had been replaced by a cylinder of bone chiselled from the tibia. He reported six cases treated successfully in this way, and maintained that the result was the same, whether the case was a clean or an infected one.

Other joints are occasionally involved in tuberculous disease, especially the sterno-clavicular. The principles already laid down should govern the treatment of them.

¹ Ahrens. Berliner klin. Woch., 1909, No. 48, S. 2167.

APPENDIX.

SOME PATHOLOGICAL PROCESSES IN TUBERCULOSIS.

BY DR. GERALD BERTRAM WEBB.

The cause of tuberculosis—a disease, as its name implies, usually characterised by the formation of little lumps—was found by Koch to be a bacillus of a streptothrix type.

Disease caused by the tubercle bacillus, is brought about to a large extent by what may be termed mechanical interference with function. Laboratory animals, after infection, do not die so much from toxæmia as from the fact that their vital organs, especially the lungs, are replaced by tuberculous granulations, and so can no longer functionate.

It is a necessary law that a parasite must not only establish its race in a host, but must also find a means of escaping from one host to another in order to perpetuate its species.

The malaria parasite is enabled to do this by means of an insect; but the tubercle bacillus must escape through other agencies, and the creation of suppuration signifies the triumph of the parasite and its probable ultimate escape.

To understand nature's method of dealing with the invasion of such a bacillus one must know something of its life history and characteristics.

The tubercle bacillus is of very slow growth, and, whereas one colon bacillus may beget millions in a day, we have found that the tubercle bacillus takes about fifteen hours to reproduce itself.

The tubercle bacillus has been analysed chemically, and entering into its composition are salts of sodium, potassium, calcium, magnesium, silicon, and phosphorus, and proteids especially of the nuclear variety. What concerns our study of pathological processes especially, 30 per cent. of the body weight of the tubercle bacillus consists of a peculiar fat or wax.

It is this wax which gives the bacillus its peculiar staining properties, and which also prohibits rapid intra-cellular digestion.

The results of the injection of dead bacilli can be studied in an animal apart from the toxin production of the living bacilli, and it has

been found that such injection can be followed by tubercle formation and even by caseation and by abscess production.

It is natural to enquire of what do tubercles consist and why are they formed.

There can be no longer any doubt that tubercle formation is an immunity phenomenon and nature's method of resisting such a parasite. Animals vaccinated against tuberculosis by attenuated cultures have been found to respond to the inoculation of virulent tubercle bacilli by a greater production of tubercles than do controls, and these tubercles in the immune animals soon resolve, whereas those in the controls go on to caseation and the animals die.

Granted that tubercle formation is an immunity process, cells which have the power of digesting the bacilli must gather around them, and so form this tubercle; this necessitates the presence in such cells of a lipase to digest the fat and wax, and a proteolytic ferment to digest the nucleo-proteid. We shall see later what body cells can fulfil this dual role.

Pathologists have long taught that a tubercle consists of giant cells, epithelioid cells, and lymphoid cells.

The "epithelioid" cells are supposed to develop from connective-tissue cells, yet in immune animals they would seem to form and collect too quickly for such a process. Again, a tubercle which develops in a fibrinous exudate can contain them.

Metchnikoff has long claimed that the giant cells of the tubercle are packed macrophages, and probably the majority of the so-called epithelioid cells will eventually be proved to be lymphocytes from the circulating blood. Lymphocytes under certain conditions have the power of reproduction.

When science thoroughly understands and explains natural laws there is always found good reason in nature's methods. Connective-tissue cells probably contain little lipase, lymphocytes have been shown to be peculiarly endowed with this ferment. It would follow, then, that nature would surely prefer using lymphocytes when she has to digest bacilli containing 30 per cent. wax. The lymphocyte also contains a proteolytic ferment—lymphoprotease.

The tissue cells of the body attempt to protect themselves against the tubercle bacillus, but it has been shown that the lymphocytes especially protect against the invasion of this parasite.

In all experimental tuberculosis the polymorphonuclear blood corpuscles—the microphages—attack and gain hold of the tubercle bacilli. Having no power to digest them, they in some manner "call out the reserves"—the lymphocytes or macrophages.

These cells—the macrophages—now attempt to devour the microphages which contain the indigestible tubercle bacilli.

Should this combat take place in the circulating blood, the microphage may carry the bacilli to some lymphoid tissue, where the infection may end, or the bacilli may triumph over the lymphocytes.

It is in such lymphoid structures, lymph-nodes and red marrow of the bone, that the disease tuberculosis seems at times to originate. The synovial membranes of joints, although possessing little lymphatic structure, yet belong in the so-called lymphatic system.

Children contain a higher number of lymphocytes in their blood than do adults, and yet 95 per cent. of children in many communities react to tuberculin by the age of fifteen. Although youth is thus infected, it is only after this age, curiously enough when the lymphocytes decline in number, that the great death-rate from tuberculosis occurs.

We have found that altitude increases lymphocytes in the blood and in this may lie the explanation of the benefit of great altitudes to tuberculous patients, and the apparent immunity of altitude dwellers to the disease.

This altitude lymphocytosis is due to a bone-marrow hyperplasia, and we have found that artificial hyperemia of the limbs can produce similar increase in the lymphocytes.

Bier's treatment, when applied to the long bones, increases the lymphocytes, and so also have we found does a hot mustard foot bath.

We have dealt in part only with the necessary lysis of tubercle bacilli. The mechanism of protection against the endotoxins so liberated is not yet understood, although it is probable that the polymorphonuclear leucocytes take a prominent part in addition to the lymphocytes.

Should these polymorphonuclear cells, however, become excessive in the blood of a tuberculous subject, it is usually good evidence that the tubercle bacillus is gaining ground. On the other hand, should the lymphocytes be increased, a better prognosis may be ventured.

The proteolytic ferment of the polymorphonuclear leucocytes, leucoprotease, and the proteolytic ferment, lymphoprotease, and the lipolytic ferment, lympholipase, of the lymphocytes are restrained under normal conditions by anti-enzymes in the blood serum.

Should these white blood corpuscles collect in masses, and should their ferments be unrestrained, we have in the case of the polymorphonuclear leucocytes the production of the "hot" abscess, as in boils, and in the case of the lymphocytes the "cold" abscess which characterises tuberculosis.

It is of interest to remember that the beneficial results which follow the introduction of an irritant paste into a purely tuberculous abscess probably arise through the induced attraction of polymorphonuclear cells with their specific ferments which may now come into action.

We do not yet know what part opsonin and agglutinin play in regard to the formation of tubercles and to the processes within tubercles. They probably both, however, assist the polymorphonuclear leucocyte in the first taking up of tubercle bacilli.

Josué has shown that in localised experimental tuberculosis in rabbits the bone marrow responds to infection by a very intense proliferation of the mononuclear leucocytes, and also that the subcutaneous injection of tuberculin will bring about similar marrow activity. A similar phenomenon occurs in man. It is therefore of great importance to understand the formation of bone marrow.

Bone marrow consists of two distinct types in the human being after the embryonic stage has been passed.

1. The Red, "Lymphoid" or Formative Bone marrow. In the young child the red marrow, originally occupying the whole shaft of the long bones, becomes changed in the diaphyses into fatty marrow, the marrow in the epiphyses, however, remaining red.

The blood-forming cells which constitute the red marrow are chiefly divided into leucoblastic and erythroblastic types, according to whether they originate white corpuscles or red corpuscles.

The leucocyte-forming cells are found to be *non-granular* and *granular*. From the non-granular, cells originate corresponding to the small and large lymphocytes of the circulating blood. From the *granular*, come the polymorphonuclear leucocytes, the eosinophiles and the mast cells.

2. The Fatty or Yellow Marrow.

This variety has nothing to do with the formation of blood cells. Fatty marrow is regarded as a transformation form of red marrow, which, however, possesses an inherent capacity to return to active blood-forming marrow should the organism, through the stress of some disease, demand great increase in blood cells.

As its name implies, fatty marrow is structurally similar to adipose tissue elsewhere.

Side-lights on the Pathology.

Tillmanns:¹ "The tuberculous foci in the cancellous tissue of the short bones and of the epiphyses of the long bones often remain for a long time the size of a pea or of a hazel-nut. They then increase

¹ Tillmanns. *Lehrbuch der allgemeinen Chirurgie*, 1901.

by a steady spread at their circumference, or by the deposition of new foci in the neighbourhood. Then the various foci coalesce and give rise to large tuberculous foci or to diffuse infiltrations.

"Where a tuberculous focus develops in bone, it gives rise to what is known as caries, *i.e.*, to the disappearance of the bone tissue in the shape of lacunar absorption, while the focus itself sooner or later undergoes cheesy degeneration, first at its centre, later at its outer portion. If the bone, at the beginning of its caseation, is not yet destroyed, it breaks down *en masse*, that is, a sequestrum is formed, which is cast loose by a process of suppuration.

"Tuberculous sequestra are characterised by particles of cheesy bone, permeated by tuberculous or cheesy granulation tissue.

"In the neighbourhood of the tuberculous focus is often seen a reactive bone production, so that the focus is shut in more or less completely by thickened, sclerotic bone. In marked cases of this sclerosis the bone is like ivory, so dense is it (eburnation), while the marrow disappears." (Here we see nature cure by shutting out the field. Author.) "In other cases, even in those that have existed for years, there is no sign whatever of bone hyperplasia."

Bradford and Lovett:¹ "In the formation of single and multiple foci of disease the first change noticeable to the naked eye is the appearance, in an already hyperæmic spot of spongy tissue, of a small, grayish, rather translucent spot, as small as can be seen perhaps, which grows more gray and increases in size; and around it a zone of hyperæmic tissue develops, and the neighbouring bone becomes a little boggy-looking from an excess of fluid transuded. There is no affection of the synovial membrane, it is purely a localised osteitis, or, more correctly, an osteomyelitis. The area of disease grows larger, and begins to look in spots yellowish, and to show a tendency to cheesy degeneration in the centre; and later in the history of the affection nodules will be found, varying in size from a pea to a hazel-nut, filled with a putty-like substance like the cheesy material found elsewhere in the body, except that here it contains spicules of bone from the trabeculae, and in the larger foci pieces of bone of considerable size. Later in the history of the affection the tuberculous nodule usually breaks down into pus. Oftener than not the original focus is surrounded by smaller tubercles which aid in its extension; but the chief work is done, as we shall see, by the erosive action of the granulations."

Lexer:² "The infarct-like, cuneiform, and conical foci result from

¹ Reference Handbook of the Medical Sciences.

² Lexer-Bevan. General Surgery, D. Appleton & Co., 1908.

the complete occlusion (embolism) of the small end-arteries of the epiphyses and metaphysis of developing bones. A rich anastomosis between these vessels is found only when the cartilages become ossified.

"In the beginning the focus is grayish red in colour and translucent, but becomes yellowish as caseation occurs.

"In the caseating form of tuberculous arthritis the synovial membrane is covered with, and partly transformed into, soft, spongy granulation tissue, while the para-articular tissues are oedematous.

"If the process gradually extends through the synovial membrane, foci of granulation tissue and abscesses develop in the parasynovial tissues, which may later rupture through the skin and lead to the formation of fistulae.

"The reactive changes occurring in the surrounding tissue also belong to the anatomical picture of joint tuberculosis. These changes affect the connective tissues and periosteum. All the soft tissues, the joint capsule, the ligaments, the tendon sheaths, likewise the subcutaneous tissue, are transformed by the chronic hyperplastic inflammation into firm cicatricial masses."

larity of joint surface as if the bone had previously been eaten away and then covered over with fibrous tissue. The surface of the condyles of the femur is irregular. On one condyle cartilage is present, quite smooth at its periphery. The centre of this condyle is covered by broken connective-tissue adhesions. Surface of the other condyle is very rough, and is everywhere covered by similar connective tissue. The articular surface of the patella is covered by dense connective tissue.

Micros.—Section from the tuberosity of the tibia shows one or two small areas of tuberculosis. Evidences of much previous rarefying osteitis. Cartilage covered with connective tissue. (Most of the bone slides were negative.)

A. Head of tibia. B. Synovial membrane.

Synovial membrane. A very few miliary tubercles. A zone of calcification is apparent in one spot. Free surface covered by fibrin and undergoing degeneration. Much obliterating endarteritis.

Lab. No. 22. Hospital, —. No. 12903.

Operator,— Admitted July 18, 1904. Discharged August 24, 1904. Cured.

Clinical diagnosis, hypertrophic lig. alaria.

Name, M. S. Age, 15. Sex, M. Occupation, pedlar.

Specimen.—Ligamenta alaria.

Duration, seven months. Stiffness, pain, and swelling, gradually increasing. No history of injury. Pain only on motion. Now marked disability, though knee can be used for walking.

Exam.—Leg in extension. Knee is swollen and contains fluid. Its contour is changed. Local heat present, joint tenderness absent. No muscular spasm. One inch atrophy of thigh and calf.

Operation.—August 25, 1904. Incision over internal condyle, opening joint. Fluid escaped. Capsule found much thickened, and fringes of lig. alaria much enlarged, pale and greenish white. These were excised. Joint irrigated and closed. Bone apparently normal. *Pathological report*—not tubercular; simple inflammation.

February 19, 1909. Patient cannot be found.

Specimen.—Section of lig. alaria shows tuberculosis.

Lab. No. 24. Hospital, —. No.

Operator,— Admitted April, 1903. Discharged,—

Diagnosis, tubercular arthritis of knee.

Name,— Age, 64, Sex,— Occupation,—

Specimen.—Entire knee-joint.

One year ago slight grating, and circumarticular thickening. Plaster for two weeks. Since then no treatment.

Exam.—Marked effusion into joint. Thickened soft parts, cedema and pitting. Grating of bone ends and muscular spasm. Ends of bone thickened.

Specimen.—Patella has in centre a soft area about 1 cm. in diameter. All synovial membrane is thickened and congested and filled with tubercles. The ends of tibia and femur are apparently normal. Soft parts surrounding tibia contain discrete tubercles. The femur and tibia cut easily with a razor.

Micros.—Tuberculosis of patella and of soft parts. Obliterating endarteritis.

Observe how in the specimen of condyle of femur the tuberculosis is starting in at the side of the cartilage. Note also how the deeper layers of the synovial membrane seem to have escaped.

A. Patella. B. Femur and tibia. C. Synovial membrane.

Primary focus in patella.

Lab. No. 60.

Hospital. —.

No.

Operator,—.

Admitted January 23, 1905. Discharged February 4, 1905. Improved.

Clinical diagnosis, tuberculosis of the elbow.

Laboratory diagnosis, tuberculosis of the elbow.

Name, M. O'B.

Age, 16.

Sex, F.

Occupation, salesgirl.

Specimen.—Heads of humerus, radius, and ulna.

In 1901 patient began to have pain and disability in her left elbow; five months after beginning of symptoms, November 14, 1901, she entered the hospital and submitted to a resection of the joint. (B.) The account of the operation says that a soft area was found in her ulna, and one in back and inner aspect of humerus, which were curetted out at the time of the excision. The joint was put up in extension, on a splint, with drainage. She was discharged from the hospital on January 10, 1902. On February 12, 1902, she was readmitted and was again operated upon. This time the elbow was opened up, and the sinuses curetted and carbolicised. (M.) Discharged March 29, 1902. From this time until her admission in 1905 six abscesses in the elbow were opened.

Exam.—On admission in 1905 left elbow was swollen and red, flexed at about a right angle. Old scars of previous operation present about the joint. One sinus above external condyle. Atrophy of arm. Motion limited. Heart and lungs normal.

January 24, 1905. Resection (B.) "Bones found in fairly good condition, but a considerable quantity of tuberculous tissue between them." One-half inch sawn from ends of bones. Sewn up with drainage. Arm put up in plaster of Paris at right angle.

April, 1909. After her discharge from the hospital in 1905 the patient had a succession of small abscesses about her elbow. A sinus would heal up, break down, heal up, etc., until February, 1907, when Bier treatment was started. After that only one abscess broke. For past year the elbow has been healed, with no treatment. Patient is now in health and has gained in weight; works for her living. Elbow fairly useful. Passive flexion and extension free, active impossible. Rotation free. Motion in hand and fingers normal.

Macros.—(Specimen is from third operation.) Bones appear perfectly normal.

Micros.—Bone. Perfectly clear, except at one spot at surface of radius. Synovial membrane loaded with tubercles.

Lab. No. 98. Hospital, —. No. 153.

Operator,—. Admitted,— Discharged, March 8, 1906. Improved.

Diagnosis, tuberculosis of wrist.

Name, J. O'D. Age, 55. Sex, M. Occupation,—
614 Bloomfield Ave., Montclair, N. J.

Specimen.—Lower end of radius, and carpal bones.

Previous history unascertainable.

Exam.—Left wrist thickened and reddened. No motion present in it. Sinus on ulnar side of dorsal aspect. Tenderness. Atrophy of arm. Motion of fingers limited.

February 28, 1906. Exeision of wrist.

February 13, 1909. Patient seen to-day. He was operated on for the sixth time four days ago by Dr. M. under cocaine. The operation consisted in opening an abscess in the wrist. Only a few inches of fore-arm bones are left. His fingers are distorted and he wears a splint. His flexor tendons are badly involved. He works for a living and is generally in health.

Macros.—Section of radius shows slight involvement at edge of cartilage. Section of carpal bones shows involvement about periphery. Radius slightly involved, some carpal bones much involved, others very slightly, one not at all.

Micros.—Tuberculosis of carpal bones and of radius. Tuberculosis of synovial membrane. The tuberculosis of radius is immediately under the cartilage, in a thin layer, and in one small spot about 1/4 inch from the cartilage. The carpal bones are also involved, immediately beneath the cartilage.

Synovial membrane. Superficial tuberculosis. The deeper layers are not involved. Much obliterating endarteritis.

A. Radius. B. Carpal bones. C. Synovial membrane.

Probably primary bony focus.

Summer of 1909, amputation of forearm.

Lab. No. 109. Hospital,—. No. 12832.

Operator,—. Admitted,— Discharged,—

Diagnosis, tuberculosis of tarsal bones.

Name, W. Age, 17. Sex, M. Occupation,—

Specimen.—Tarsal bones.

Tuberculous adenitis three years ago. Sprained right ankle one and a half years ago. Six months later a weight fell on the same foot. Patient in bed for several days afterward, and since then has been unable to bear weight on his foot.

Exam.—Right foot. From external malleolus forward to metatarso-phalangeal joint is a fusiform swelling, 1 1/2 inches wide at widest part, tender to pressure at lower part.

March 17, 1907, excision of tuberculous area. The tendon sheath was found fatty and seemingly infected with tuberculosis. Sheath of perineal tendons removed thoroughly, and part of tendon also. Cuboid and part of calcaneus also removed.

Macros.—Bones are so broken up that they cannot be identified.

Micros.—Bone tuberculosis and synovial tuberculosis both present.

A. Section of tarsal bone. B. Synovial membrane.

Lab. No. 115. Hospital,— No. 12814.

Operator,— Admitted March, 1906. Discharged,—

Diagnosis, tuberculosis of knee.

Name, K. Age, 20. Sex, F. Occupation,—

Specimen.—Articular ends of tibia and femur.

On January 30, patient hurt her right knee. She was in bed for two weeks and since then her leg has been contracted.

Exam.—Right knee swollen and tender over internal tuberosity of tibia. Atrophy of thigh and of calf.

March 10, 1906. Resection of knee-joint. Ends of femur, tibia and fibula removed. Surrounding tissue and bursa also removed. (No description of lesion given.)

Macros.—The articular surface of both bones is extensively involved, and in the head of the tibia is what appears to be a primary bony focus. Two spots of softening are found, but on sawing bone through them longitudinally, no tuberculous focus can be identified.

Micros.—Joint surface of tibia extensively involved. This involvement apparently does not approach epiphyseal line, but section does not take in focus of disease. Synovial membrane shows tuberculosis.

A. Head of tibia. B. Synovial membrane.

Bony focus.

Lab. No. 120. Hospital,— No. 366.

Operator,— Admitted April, 1906. Discharged May 23, 1906. Cured.

Diagnosis, tuberculosis of shoulder.

Name, H. J. Age, 18. Sex, F. Occupation,—

Specimen.—Head of humerus.

Two years ago, after heavy lifting, patient experienced stiffness and disability in right arm, and later swelling, redness and sensitiveness in the shoulder. Symptoms disappeared after about one month. Six months ago, after hard work, the shoulder grew stiff and painful. No swelling nor redness was

present, but great tenderness. The patient applied for treatment at a hospital, and her joint was moved under an anæsthetic. This caused an aggravation of the symptoms.

Exam.—Atrophy of muscles about the joint and in the arm. No redness nor swelling. Some tenderness over head of humerus. All motions limited, grating in joint. Enlarged axillary lymph-nodes.

April 21, 1906, excision of head of bone and curetting of focus in the shaft.

Macros.—General involvement of the joint surface and a large bony focus in the head of humerus.

Micros.—Tuberculosis of bone, and of synovial membrane.

Primary bony focus.

Lab. No. 137. Hospital,— No. 416.

Operator,— Admitted,— Discharged June 13, 1906. Cured.

Diagnosis, tuberculosis of knee.

Name, C. I. Age, 33. Sex, M. Occupation,—

Specimen.—Heads of tibia and femur, and the patella.

For two months patient has suffered from pain and swelling in his left knee, worse at night. No history of trauma.

Exam.—Left knee flexed. Motion 90° to 115° . Muscular spasm. Marked atrophy of thigh and calf. Increase of temperature. Marked tenderness over outer condyle of femur and inner tuberosity of tibia. Patella slightly movable.

May 8, 1906. Resection of joint. The synovial membrane was found thickened and gray in colour. No bony focus was found.

Macros.—Bones apparently normal. Synovial membrane thickened.

Micros.—Bone. No sign of tuberculosis. Synovial membrane; thickened arteries. Chronic inflammation. Hemorrhage into membrane. No tuberculosis. *Probably syphilis.*

A. Bone. B. Synovial membrane.

Lab. No. 180. Hospital,— No. 3593.

Operator,— Admitted July, 1906. Discharged,—

Diagnosis, tuberculosis of tarsus.

Name, M. M. Age,— Sex, F. Occupation,—

Specimen.—Talus.

History unascertainable.

July, 1906. Operation. Astragalectomy. "Disease found in talus, navicular, and calcaneus joints."

Macros.—Bone apparently normal. Synovial membrane thickened.

Micros.—Bone. Considerable productive osteitis. Joint surface covered with fibrous tissue, which has in most places replaced the cartilage. A few remnants of cartilage are seen covered in by this fibrous tissue. Patches of lymphoid cells in bone. No tuberculosis. No syphilis. Synovial membrane; Some round-cell infiltration. Thickening of blood vessels. No tuberculosis.

A. Bone. B. Synovial membrane.

Lab. No. 228.

Hospital,—.

No. 949.

Operator,—.

Admitted November, 1906. Discharged December 13, 1906. Improved.

Diagnosis, tuberculous arthritis of knee.

Name, A. A.

Age, 28.

Sex, M.

Occupation, steamfitter.

Specimen.—Bones of knee.

Duration, twenty-six years, or six weeks. At four years of age patient was treated by G. with plaster of Paris and braces, the treatment lasting for two years. Since then he has been well until six weeks ago, when pain began in the joint. He has suffered since from pain and disability. General health not affected.

Exam.—Not given. Patient discharged wearing plaster of Paris after having his knee resected.

Macros.—Joint badly affected. Adhesions have glued patella to femur. The internal condyle is apparently eaten away, and to a somewhat less extent, the opposing surface of tibial head. No involvement of the bones at lines of resection. No bony ankylosis. Synovial membrane thickened.

Micros.—*Bone.*—In places productive, and in places rarefying osteitis. Cartilage gone, its place taken by layers of fibrin, badly degenerated. At one spot is an area that is *probably tuberculous*. *Soft parts.*—*No tuberculosis apparent*. *Marked* arterial thickening present.

January, 1910. Further sections of bone and soft parts.

Bone.—Tuberculous tissue extends in under the cartilage at the side, and here the cartilage is distinctly fibrillated, and the bone trabeculae are undergoing rarefying osteitis. Some of them are necrotic. Part of the tuberculous tissue is also necrotic. Further in, the cartilage has been separated from the underlying bone and its whole structure is blurred and indistinct. Part of the cartilage has been replaced by fibrous tissue.

B. Well marked tuberculosis of synovial membrane, with necrotic tissue on its free surface. Obliterating endarteritis. At some parts can be seen new granulation tissue.

Origin unknown. This shows a case breaking out twenty-six years after supposed cure by conservative treatment.

Lab. No. 235 and 235 1/2. Hospital,—. No. 2714.

Operator,—. Admitted November 28, 1906. Discharged July 8, 1907. Cured.

Diagnosis, tuberculosis of knee and of hip.

Name, J. R. Age, about 35. Sex, M. Occupation,

Specimen.—Knee-joint and hip-joint, and lower end of femur.

Previous history and duration of disease unrecorded. Patient had evidently suffered from some disease in his right lower extremity, and was improving when he fell from street car. Since then he has suffered pain and disability. Knee is swollen, thickened, and limited in motion.

December 20, 1906. Right knee-joint opened, and found full of bloody fluid. "On the inner side of the joint, attached to femur, was a hard fibrous growth." The medulla of the bone was soft and broken down. This condition seemed to run well up the shaft. *Resection*.

About three weeks later, on account of the suffering the patient experienced in his tuberculous right hip (sinuses, limitation of motion, etc.), at his own request an amputation was done at the hip. The head of the bone had a worm-eaten appearance, and was so tightly adherent to the acetabulum that disarticulation was effected with difficulty.

Macros.—Knee. Evident old supracondylar fracture. Hip. Worm-eaten, eroded head. More or less softening of spongy portion of bone below level of trochanter. No bony focus.

Micros.—Lower end of femur shows *repair of fracture*. Hip. Tuberculosis along joint surface of bone at one spot, but not deep in it. Cartilage gone, except in small island. Its place is taken by fibrous tissue. Productive osteitis. Some round-cell infiltration of deeper portion of bone. Several small cysts directly under joint cartilage. Evidently joint was in stage of repair; islands of cartilage continuous with fibrous tissue at sides, and in places covered by the fibrous tissue. One or two areas of necrosis on surface. The trabeculae of bone seem smaller than normal.

A. Section from lower end of femur. B. Sections from trochanter and head of femur.

Lab. No. 251. Hospital,—. No. 14132.

Operator,—. Admitted about January 1, 1907. Discharged,—

Diagnosis, tuberculosis of humerus.

Name,— Age,— Sex,— Occupation,—

Specimen.—Only slides available.

Nine months ago, patient fell and struck arm. Continued work. One month later began to have pain and disability. At end of two months needle inserted on account of swelling, and a thick yellow fluid withdrawn.

Exam.—Over internal and external epicondyles are sinuses discharging slightly. Flexion limited. Pronation and supination normal.

January 5, 1907. Excision of bone from right humerus. Epiphysis of humerus contained a little pus. Joint not entered.

Pathological report. Tuberculosis of humerus, but no joint involvement.

Micros.—Clippings from the soft parts show tuberculosis.

Bone tuberculosis without joint involvement.

Lab. No. 288.

Hospital.—

No. 140

Operator.—

Admitted January 21, 1907. Discharged February 22, 1907. Cured.

Clinical diagnosis, tuberculosis of knee.

Name, J. K.

Age, 20.

Sex, M.

Occupation,—

Specimen.—Patella, heads of tibia and femur, and synovial membrane.

About seven years ago, after injury to left knee, patient began to suffer from swelling and weakness of the joint; no pain. This has gradually grown worse. Occasionally some pain in walking. Has not lost weight and does not cough.

Exam.—Left knee is swollen; 1 1/2 inches larger in circumference than right. No redness, tenderness, nor increased local temperature. Swelling seems to be both in joint and in circumarticular tissues. No dancing patella. Bogginess on either side of patella. Slight sensitiveness over inner aspect of head of tibia. Atrophy of muscles of thigh and of calf. Leg in extension; flexion limited to right angle. Heart and lungs normal.

January 24, 1907. Resection of knee. Incision divided lig. patellæ.

Pathology. The synovia was found thickened, and the ends of the bones were soft, and there was a cavity extending for several inches down behind the tibia (or fibula).

Half an inch was removed from each bone, three nails were used to fasten bones together, the cavity behind tibia (or fibula) was eurented out. Wound closed without drainage.

One nail was removed on the thirteenth day, and the other two on the nineteenth. Temperature 102° for five days. Post-operative plaster of Paris applied on nineteenth day. Patient walked on twenty-third day.

Macros.—Bone sound at lines of section. No bony focus discoverable. Cartilage on condyles worn off in spots, and bone eburnated. Near these areas the tuberculosis seems to have attacked the bone. The cartilage is also degenerated over head of tibia and fibrillated over patella. Synovial membrane hypertrophied and thickened.

Micros.—Bone shows tuberculosis along joint surface and in one spot near the joint. Joint cartilage in most places has disappeared and the bone is covered by fibrous tissue, infiltrated in places with tuberculosis. Productive osteitis is present. Synovial membrane is thickened, and in most places, on free surface, much degenerated, necrotic. The tuberculosis goes down to the deep fibrous layer of joint capsule.

A. Bone. B. Synovial membrane.

Apparently synovial tuberculosis.

Lab. No. 272. Hospital,— No. 81.

Operator,— Admitted,— Discharged January 29, 1907. Improved.

Diagnosis, tuberculosis of wrist.

Name, A. G. Age,— Sex, M. Occupation,—

Specimen.—Radius, ulna, some wrist bones and synovial membrane.

About ten years ago the left metacarpus became swollen. Two years later operated on by Dr. —. Four years ago the left wrist began to swell and has been slowly growing worse. The wrist has been stiff for six months and for four weeks it has been painful. Pain is increased by motion and is worse at night. Patient has gained in weight in past eight years. Pulmonary examination not recorded.

January 26, 1907. Resection of wrist through posterior incision.

Pathology. Tendon sheaths found swollen and infiltrated with tuberculous tissue. Lower extremities of radius and ulna, and all the carpal bones diseased.

The lower ends of radius and ulna were sawn through 1 inch above joint. All the carpal bones were removed except the trapezium and pisiform. All other tuberculous tissue cut away. Iodoform powder applied. Wound sewn up without drainage. Dry dressing. Anterior molded splint.

Macros.—No evidence of bone focus discernible, though the bones are badly eroded in places, and the tuberculosis goes deep into radius.

Micros.—The section of radius shows tuberculosis on surface, running also considerably into bone. Rarefying osteitis is present, and a small area of bone is necrotic. Cartilage present in places, covered over by fibrous tissue (shading off into it, so to speak), not necrotic. Synovial membrane shows tuberculosis; its vessels are thickened; in places it is necrotic.

A. Lower end of radius. B. Synovial membrane.

Lab. No. 303. Hospital,— No.—

Operator,—

Admitted February 16, 1907. Died May 31, 1907. General tuberculosis.

Diagnosis, tuberculosis of left knee.

Name, R. C. Age, 50. Sex, F.

Specimen.—Entire left knee-joint.

About nine months ago patient had an attack of "inflammatory rheumatism," involving hands and ankles. This grew better and a few weeks later patient began to suffer from a painful red swelling on the outer side of the right ankle, which was opened shortly afterward at the hospital. Operated the second time at the hospital on September 13, 1906. A bone scraping and curetting of right ankle was done for tuberculosis. In November, 1906, an amputation at the middle of the right leg was done and she was discharged, cured, on January 5, 1907. No mention was made in the history of her stay in the hospital at that time of any trouble with her left knee.

Exam.—(February 16, 1907.) Lungs extensively involved, albumin in urine. Left leg atrophied. Knee-joint greatly swollen and painful. Motion limited.

March 8, 1907. Extra-articular excision of knee. Ends of bones united with chromic gut; wound sewn up without drainage. Posterior plaster-of-Paris splint.

Pathology. Ends of bone found to be cheesy and tuberculous looking, even when scooped out with curette.

April 22, 1907. Amputation of left thigh.

May 31, 1907. Exitus. No autopsy.

Macros.—Bones appear intact. Joint surfaces smooth. Synovial membrane thickened and extensively involved, the involvement going down to dense fibrous layer underlying membrane. Fibrillation of cartilage. Bone is normally dense.

Micros.—No tuberculosis in bone. Synovial membrane shows profuse and even distribution of tuberculosis throughout.

A. Patella. B. Synovial membrane.

Primary synovial.

Lab. No. 318.

Hospital,—.

No. 440.

Operator,—.

Admitted March 12, 1907. Discharged June 15, 1907. Improved.

Clinical diagnosis, tuberculosis of the tarsal bones.

Name, P. McG.

Age 23.

Sex, M.

Occupation,—

Specimen.—Talus, and synovial membrane.

A year ago, patient injured right ankle slightly, and two weeks later it began to swell and to become painful. This swelling has slowly increased. The pain was severe for the first two months, but not since. Patient has lost fifteen or twenty pounds in weight.

Exam.—Right ankle is swollen, and is slightly sensitive. Heart and lungs clear.

March 18, 1907. Resection of talus.

Pathology. The talus was found to have undergone extensive tuberculous changes, as also the navicular and internal malleolus. The cuneiform bones, the cuboid, and the external malleolus were soft and spongy, but were apparently not tuberculous.

The talus and scaphoid were removed, together with the malleoli and articular surface of tibia. Diseased synovia also removed. Drainage by iodoform tape. Dry dressing.

January, 1909. Ankle in excellent condition. Firm ankylosis. Man walks on his foot and earns his living. He has since had his testicles, seminal vesicles, part of his sternum, and seventh rib removed for tuberculosis. He has gained twenty-five or thirty pounds.

Macros.—Bone rather soft, the seat of fatty osteomalacia. No tuberculosis apparent. Cartilage smooth.

Micros.—Bone shows tuberculosis at the periphery, but in no place where it is covered by cartilage. Productive osteitis. Synovial membrane shows distinct tuberculosis. Soft parts have thickened arteries.

A. Bone. B. Synovial membrane.

Lab. No. 453. Hospital, —. 1st Div. No. 593.

Operator,—. Admitted July 20, 1907. Discharged July 27, 1907. Improved.

Diagnosis, tuberculosis, of the elbow.

Name, G. L. Age, 27. Sex, M. Occupation,—.

Specimen.—All three bones, synovial membrane.

E.'s patient. O. P. D. No. 1224.

Duration, four years. Stiffness, pain, and disability, gradually growing worse.

Exam.—Left elbow in pronation and semi-flexion. Thickening about joint. Muscular spasm, and limitation of motion. Enlarged epitrochlear.

July 22, 1907. Resection of the elbow. The ends of all the bones of the elbow-joint were found badly diseased, the synovia also. Pus in joint, bones bleeding when removed. "At one spot the process had emigrated through the capsule and entered the surrounding tissue." Plaster of Paris at right angle. Wound closed.

Macros.—Humerus is very slightly involved, and only directly under cartilage in a layer, as if the tuberculosis had spread in from the sides, and practically dissected the cartilage off. Ulna is considerably involved, in same manner. Synovial membrane extensively involved.

Micros.—Humerus. Tuberculosis in layer under articular cartilage. Connective tissue over the top of cartilage. Ulna badly tuberculous. One small piece of secondary calcification in area of necrosis. Around this is no definite tuberculosis, but good fibrous tissue. Is this the original focus, and has the process died out here?

A. Capitellum. B. Ulna. C. Synovial membrane.

Probably bony focus.

Lab. No. 799. Hospital, —. No. 4405.

Operator,—. Admitted,—. Discharged December 10, 1907. Cured.

Diagnosis, tuberculosis of the hip.

Name, M. D. Age, 19. Sex, F. Occupation,

Specimen.—Head of femur.

Duration, four months. Acute symptoms. In bed with extension. Marked deformity. Deep fluctuation over hip-joint.

September 4, 1907. Resection of hip, through anterior incision. Head of bone found eaten away and lying in pus. Acetabulum diseased and lined by soft granulations. Wound sewn up without drainage. Long plaster-of-Paris

spica. Primary union. At time of discharge, patient walked with a moderate limp. No sign of active disease. Thickening of upper part of femur. One inch shortening. A. G. E. 180°, A. G. F. 140°.

Macros.—Head of bone badly eroded.

Micros.—A. No sign of articular cartilage. In places the articular surface of bone is covered with fibrous tissue, but in most places the bone is at the surface. *No sign of focus*. Productive osteitis. The process looks as though it were in the stage of repair.

B. Soft parts. Well marked tuberculosis of synovial membrane. Arterial thickening *well-marked*.

Later.—New bone sections. Tuberculous tissue at surface of bone. Small pieces of dead trabeculae lie in pus cells. No sign of cartilage. Its place appears to have been taken by tuberculous tissue.

Lab. No. 800.

Hospital, —.

No. 7445.

Operator, —.

Admitted August 23, 1907. Died December 10, 1907; pulmonary tuberculosis.

Diagnosis, tuberculosis of elbow.

Name, M. M.

Age, 16.

Sex, F.

Occupation, —

Specimen.—Lower end of humerus.

Duration, one year. Sub-acute symptoms.

Exam.—Elbow greatly swollen; discharging profusely through a number of sinuses. General condition very poor.

Macros.—Bone involved at extreme end. No bony focus visible.

Micros.—Bone extensively involved by tuberculosis at and near joint surface. Articular cartilage almost gone. There is a small piece left, which is being loosened by granulations from beneath. *Late synovial tuberculosis*.

February, 1910. New bone sections. These show in places rarefying osteitis, in places new bone. Only a suggestion left of what might have been cartilage. Tuberculosis of bone is present, and well-marked tuberculosis also of the fragments of synovial membrane clinging to the bone.

Lab. No. 840.

Hospital, —. O. P. D.

No.

Operator, —.

Date, November 20, 1907.

Cured.

Diagnosis, tuberculosis of metatarso-phalangeal joint of great toe.

Name, G. W.

Age, 55.

Sex, M.

Occupation, horseman.

Specimen.—

Duration, one year. Pain, swelling, and disability in right great toe. His joint was excised on November 20, 1907. December 15, 1907, the wound was healed, except at one small spot, though considerable swelling remained. Later another spot broke down and discharged for about nine months, then the wound healed.

February 11, 1909. Patient examined. In good condition, and suffers no pain in toe.

Exam.—Shows some thickening about the joint, and about 40° motion.

Micros.—Synovial membrane shows tuberculosis. Arteries are thickened. Dead bony trabecular lying in pus cells and necrotic tissue.

A. Bone. B. Synovial membrane. C. Detritus.

Lab. No. 871.

Hospital, —.

No. 9635.

Operator, —. Admitted December, 1907. Discharged October, 1908. Cured.

Diagnosis, tuberculosis of the knee.

Laboratory diagnosis, non-tuberculous arthritis.

Name, J. P.

Age, 40.

Sex, M.

Occupation, gardener.

Specimen.—Patella and ends of femur.

Tuberculous family history. Hemoptysis five years previously. "Rheumatism" four years ago. Pain and swelling in left knee for unknown period. Marked disability.

Exam.—Patient thin and in poor condition. Left knee swollen. The swelling was soft and fluctuating. No typical muscular spasm.

December 30, 1907. Excision of the knee-joint. Masses of fat and of hypertrophied synovial membrane were dissected out. The synovial membrane was found thrown into folds with dark red villous processes in the recesses of the joint. The ends of the tibia and femur were sawn off and the patella removed. Cigarette drains were inserted and the knee was put up in plaster of Paris. Convalescence in this case was prolonged by the occurrence of pressure sores on the foot, from the plaster of Paris.

February 11, 1909. Firm ankylosis at angle of 160° . Patient's general condition good. No pain in the knee.

Macros.—Bones normal. Synovial membrane covered with villi.

Micros.—Typical "villous arthritis." Small areas of cartilage can be seen in some of the villi.

Later, 1910.—New sections of synovial membrane fail to reveal tuberculosis. A new layer of granulation tissue has formed on surface of synovial membrane, and the surface of this has taken on appearance of a synovial membrane. The arteries are much thickened.

Lab. No. 872.

Hospital, —.

No. —

Operator, —.

Admitted October 12, 1907.

Died February 12, 1908.

Diagnosis, tuberculosis of hip, chronic sepsis.

Name,

Age, 5.

Sex, F.

Specimen.—Head of femur.

Patient had been treated for rheumatism for a year before admission to the hospital. Her right buttock was diffusely swollen. Sinus discharging near the right side of the sacrum. Slight trace of albumen. Hemoglobin 40° .

November 29, 1907. Posterior drainage tubes inserted.

December 23, 1907. Temperature 99° to 105°. Discharge profuse, but drainage has not been satisfactory. Cough. Rales at both bases.

December 27, 1907. Resection of head, through anterior incision. Six ounces of pus evacuated from abscess, partly in thigh and partly in pelvis.

Macros.—Complete destruction of the articular cartilage, exposing the bone. No evidence of bony focus.

Micros.—Tuberculosis of both bone and synovial membrane. Bone is affected only at the joint surface.

Lab. No. 875.

Hospital, —.

No.—

Operator,—. Admitted December 26, 1907.

Clinical diagnosis, tuberculosis of the elbow.

Laboratory diagnosis, tuberculosis of the elbow.

Name, J. R.

Age, 38.

Sex, M.

Occupation, coachman.

Specimen.—The articular extremities of the three bones.

For fifteen years the patient has had a small soft swelling on outside of left elbow, gradually increasing in size. Two years ago the elbow began to grow stiff. No pain at any time, until three months ago, when patient struck the elbow against a carriage wheel. Since then it has been painful.

Exam.—Elbow swollen and sensitive, flexed at a right angle. Flexion and extension markedly restricted, rotation absent. Atrophy of the arm.

December 28, 1907. Resection of elbow. Joint opened by posterior incision. Ends of ulna and humerus appeared normal, but on the head of radius was a bunch of granulations. The heads of all three bones were resected, the joint was sewn up without drainage, and was put up in plaster of Paris in a position of right-angled flexion. The further course was uneventful, except that the wound broke down in one spot, several weeks after, and discharged slightly for two or three months.

October 16, 1908. Patient is at work as a porter and has a useful, movable elbow. The wound is closed, and the disease is cured.

Macros.—The head of radius contains a focus which has perforated the articular cartilage. The other bones appear normal.

Micros.—Focus of tuberculosis in the head of the radius. Ulna normal; tuberculosis of synovial membrane attached to it.

A. Radius. B. Ulna. C. Soft parts.

Apparently primary focus in head of radius.

Micros.—(Continued.) A. The granulation tissue can be seen to have cut off the nutrition of the cartilage and to have burst through into the joint. All about this focus can be seen the dead bone trabeculae, or rather, in the focus. The tuberculous granulations can be seen in patches all through this part of the bone.

B. Normal bone, tuberculosis of synovial membrane attached to it.

Lab. No. 878. Hospital, —. No. —.
 Operator, —. Admitted, — Died. Haemophilia.

Clinical diagnosis, tuberculosis of knee; at operation, "villous arthritis."

Laboratory diagnosis, hæmarthrosis.

Name, — Sex, M. Age, 27. Occupation, —

Specimen.—Synovial membrane of joint.

Two sisters died of tuberculosis. In childhood, patient was said to have had rheumatism in both elbows and in left shoulder. Since then he has been healthy. One year ago the left knee began to swell. It has not been painful at any time, and has not kept him from work. "At one time it was like a balloon."

Exam.—Patient well nourished, but of slight build. Long thin face. Knee is swollen and full of fluid. Joint-pouch much distended on front of femur. Synovial membrane feels very much thickened. No crepitus, muscular spasm, nor atrophy. Four inches enlargement.

Operation.—Joint opened. Found full of bloody fluid. Synovial membrane everywhere covered by long slender villi, dark red in colour. The diagnosis was changed to villous arthritis, and synovectomy was done.

The patient was a hæmophiliac, and died shortly afterward of hæmorrhage.

Macros.—Synovial membrane on sides of pouch under quadriceps covered by villi in great numbers, branching many times from single stem, 1/2 inch in length, looking like dwarf hepatics on a rock. Top of synovial pouch 1 1/2 inches thick, and laminated. Old and recent clots undergoing organisation, and bands of fibrin. On posterior surface of membrane the tissue is smooth and glistening.

Micros.—No signs of inflammation or tuberculosis.

Fluid and ground-up membrane injected into guinea-pig with negative result.

Lab. No. 886. Hospital, —. No. 311.

Operator, —. Admitted January 14, 1908. Discharged April 19, 1908. Cured.

Diagnosis, tuberculosis of knee.

Name, G. S. Age, 17. Sex, F. Occupation, tailor.

Specimen.—Patella and ends of femur and tibia.

About one and one-half years ago the left knee began to swell, and became painful. The symptoms have persisted and have grown worse. For four weeks the patient has been unable to walk.

Exam.—Swelling, increased temperature, tenderness at sides of patella. Fluid in joint, dancing patella. Knee in slight flexion. Flexion limited to 90° and painful. Muscular spasm. Atrophy of thigh and calf. No distinct pulmonary involvement.

January 23, 1908. Resection of left knee.

Pathology.—Very little fluid in joint. Lig. alaria fatty and hypertrophied. Synovial membrane about outer condyle of femur, and external tuberosity of tibia, blue and swollen. No bony focus found. Cartilage over the outer condyle of femur seemed thin.

Operation.—Joint opened first on inner side, as that seemed the seat of greatest pain. Nothing found, except fatty hypertrophy of lig. alaria. On outer side a tuberculous condition of the synovia was found. Heads of bones resected and the ends united with two nails. No drainage; dry dressing. Plaster of Paris.

(Operation on right knee, March 31, 1908. Removal of piece of redundant lig. alaria. Report of pathologist; no tuberculosis found.)

Macros.—Bones appear normal and cut hard. The synovial membrane is much thickened. The cartilage is covered with exudate, and in points granulation tissue encroaches on it. Semi-lunar cartilages are obscured by adhesions and by masses of granulation tissue. The disease process appears to be creeping over the articular surface of the femoral condyle.

Micros.—No evidence of bony tuberculosis discovered. Articular surface of cartilage is frayed out and broken up. Synovial membrane shows tuberculosis. In some spots the membrane is covered with fibrin, and is degenerated at the surface.

A. Tibia, patella, and femur. B. Synovial membrane.

Apparently primary synovial tuberculosis.

Lab. No. 893.

Hospital. —.

No. 850.

Operator. —.

Admitted Nov. 18, 1907. Discharged December 17, 1907; improved.

Diagnosis, tuberculosis of the elbow.

Name, T. F.

Age, 27.

Sex, F.

Occupation. —

Specimen.—Bones of elbow-joint.

About seven and a half months ago without history of injury, patient began to experience "soreness" and stiffness in her elbow. Following onset, there was a distinct remission of symptoms for two weeks, then a return with increased severity.

Exam.—Slight swelling of the joint. Slight sensitiveness to pressure posteriorly external to the olecranon, and also anteriorly. Fluid in joint. Limitation of extension and flexion to about half normal. Pronation and supination free. Little pain on motion. No bony tenderness. Bluish red swelling, size of walnut, in left supra-clavicular region—broken-down lymph-node. No distinct pulmonary involvement.

November 20, 1907. Positive ophthalmo-tuberculin reaction.

November 26, 1907. Excision of elbow through posterior incision. The whole of the synovial membrane was thickened, infiltrated, and soft; typical tuberculous tissue. Small amount of fluid in joint. No breaking down of tissue, nor caseation, nor fibrous repair. No lesion of bony parts could be discovered.

The heads of the three bones were resected, care being taken to keep on the olecranon above insertion of brachialis anticus. The synovia was thoroughly dissected out, and the wound dusted with iodoform powder. Drainage. Forearm put up in extension, molded plaster splint.

April 9, 1909. Patient in health. Elbow presents no sign of active disease, except increase of surface temperature. Pronation and supination free. A. G. E. 160°. A. G. F. 145°. Girl uses the joint in working.

Macros.—Bone apparently normal. Synovial membrane filled with tubercles.

Micros.—Slide from internal part of trochlea negative. Slide from the external part of trochlea and that from the ulna show involvement at the edges of the cartilage, and for a very short distance underneath the cartilage. *Synovial membrane*: Tuberculosis has involved the entire thickness of the membrane. A cyst can be seen in the synovial membrane.

A. Section from ulna and humerus. B. Synovial membrane.

Apparently primary synovial.

Lab. No. 900.

Hospital, —.

No. 210.

Operator, —. Admitted January 30, 1908. Discharged March 16, 1908.

Clinical diagnosis, tuberculosis of right knee.

Laboratory diagnosis, probably old healed tuberculosis.

Name, B. E.

Age, 28.

Sex, M.

Occupation, —

Specimen.—Articular ends of tibia and femur, and the patella.

Duration, ten years, with periods of quiescence. Pulmonary and rib (necrosis) complication. Knee at entrance was practically ankylosed, patella fixed. No swelling, heat, nor tenderness.

February 1, 1908. Resection. Joint cavity found practically obliterated. Bony and fibrous union between femur and tibia. Heads of bones were sawn off, and a small piece of diseased bone was curetted from the back of external condyle. The bones were brought into apposition, and were nailed. The wound was sewn up tight, and plaster of Paris was applied.

Nails and sutures were removed on the twenty-second day. Knee in plaster when patient was discharged on March 16, 1908.

Macros.—Articular surfaces of all three bones are roughened. At one place on condyle of femur a sequestrum is evidently being formed. The bone involvement seems mostly superficial. Very slight evidences of synovial involvement. Apparently the disease process was pretty well healed.

Micros.—No tuberculosis in bone. One area of necrotic bone. The cartilage shows signs of repair. It is covered in spots by fibrous tissue and is roughened and dentated. Areas of calcification at surface of cartilage and productive osteitis under cartilage. Synovial membrane shows no tuberculosis.

A. Sections from patella and from femur, one of the latter going down to the sequestrum. B. Synovial membrane.

Probably old healed tuberculosis.

Later.—Four more sections of the soft parts appearing to be the worst affected show new granulation tissue and areas of necrosis, but no tuberculosis.

Lab. No. 923.

Hospital,—.

No. 10830.

Operator,—. Admitted February 18, 1908. Discharged June 6, 1908; improved.

Clinical diagnosis, tuberculosis of the elbow.

Laboratory diagnosis, probably extra-articular tuberculosis.

Name, V. P.

Age, 26.

Sex, M.

Occupation,—

Specimen.—Synovial membrane and fragments of bone.

(Patient speaks no English, history is therefore unreliable.) Eighteen days ago, he began to have pain and swelling in left arm and elbow. Pain has grown worse.

Exam.—Patient in poor condition. Elbow in semi-flexion. Swelling, redness, sensitiveness and increase of local temperature. Limitation of motion present, especially of rotation.

February 19, 1908. Large pocket of pus evacuated above external condyle. Joint opened. The joint surfaces appeared normal. The external condyle appeared to be involved. This was chiseled away, and the wound was sewn up tight without drainage. Plaster of Paris at right angle.

March 2, 1908. Plaster of Paris removed. Wound slightly infected superficially. Cavity where pus had been was aspirated, and about an ounce of bloody serum withdrawn. Plaster of Paris was applied.

Later, wound broke down completely, exposing bare bone. The lungs became affected.

Macros.—The bone above external condyle is so broken up that little can be told from its gross appearance, but it cuts hard, and appears normal.

Micros.—Synovial membrane shows tuberculosis.

Lab. No. 959.

Hospital,—.

No. 311.

Operator,—. Admitted January 14, 1908. Discharged April 19, 1908.

Clinical diagnosis, tuberculosis of knee.

Laboratory diagnosis, no tuberculosis.

Name, G. S.

Age, 17.

Sex, F.

Occupation, tailor.

Specimen.—Lig. alaria, inner side of right knee.

Negative at operation.

This is the right knee of laboratory case 886, whose left knee was operated upon, January 23, 1908, for tuberculosis. See history.

Micros.—No sign of tuberculosis.

Lab. No. 924. Hospital,— No.
 Operator,— Operation February 21, 1908.
 Diagnosis, tuberculosis of second metacarpophalangeal joint.
 Name, B. A. Age, 25. Sex, M. Occupation.
Specimen.—Finger.
 Duration seven months. Disease began with swelling and very little pain. Two weeks ago, the swelling was opened by private physician. Since then a thin discharge has persisted. Cough for two years. Hemorrhages.
Exam.—Swelling and tenderness over affected joint, with discharging sinuses on dorsal and palmar surfaces.
 February 21, 1908. Amputation of finger.
 March 23, 1908. Patient has severe pulmonary involvement.
 March 23, 1909. Finger healed slowly, but completely. Patient died about the middle of November, 1908, of pulmonary tuberculosis.
Micros.—Neither bone shows tuberculosis, except at the joint surface. Metacarpal bone. Cartilage over the bone is gone. At one spot, connective-tissue repair covers the end of the bone. Productive osteitis.
 Phalanx. Beautiful productive osteitis. Cartilage has entirely disappeared. End of bone is covered by tuberculous granulation tissue.
 Synovial membrane has been replaced by tuberculous granulation tissue. Obliterating endarteritis in soft parts.
 A. Bone. B. Soft parts.
 Almost certainly primary synovial tuberculosis.

Lab. No. 989. Hospital,— No.
 Operator,—
 Admitted March, 31, 1908. Discharged April 15, 1908. Improved.
 Clinical diagnosis, tuberculosis of knee. (Left.)
 Laboratory diagnosis, non-tuberculous arthritis.
 Name, S. L. Age, 20. Sex, M. Occupation, stenographer.
Specimen.—Synovial membrane. — hospital, O. P. D. 8797.

The patient had been under treatment for four years, by plaster of Paris, braces, etc., with what appeared to be a chronic synovial type of tuberculosis, and had had his joint opened one year before this operation, following directly a course of Bier treatment. At that time a large amount of fluid was evacuated, and the lig. alaria, which were enormously thickened, had been trimmed partially away. Permission could never be obtained for a radical operation.
 April 1, 1908. Joint opened. The articular ends of the tibia and femur were found covered with granulations, and the articular cartilages seemed almost destroyed. The granulations were scraped away, and the synovial membrane

Another slide (A-1) shows tuberculosis immediately under cartilage in the bone. The process can be seen to have travelled down from focus to the joint directly under periosteum.

Synovial membrane does not show tuberculosis.

A-1. Longitudinal section of lower end of femur taking in portion of external condyle. A-3. Cross section of half of shaft at side of focus.

Primary bony focus.

Lab. No. 1146.	Hospital, —.	No.
Operator, —.	Admitted, —	Discharged, —
Clinical diagnosis, tuberculosis of hip.		
Laboratory diagnosis, tuberculosis of hip.		
Name, M. D.	Age, 40.	Sex, F. Occupation, housework.
<i>Specimen.</i> —Head of femur.		

Patient has had pain in her hip for two years, growing worse. For past year she has been in bed, weight and pulley extension.

Exam.—Classical symptoms of hip disease; pain, spasm, disability, deformity, and limitation of motion.

November 13, 1908. Excision of hip, through anterior incision. Very little fluid found in joint. The head of the bone was largely eaten away. The acetabulum was covered with velvety granulations. The head of the bone was easily removed with a mallet and chisel, and the acetabulum was scraped. Then a large round silver-plated spike, 4 1/2 inches long, was driven through the trochanter and neck into the acetabulum. The wound was sewn up tight, and a long plaster spica was applied.

January 28, 1909. Plaster of Paris removed. Wound infected at one spot. A few drops of pus also in the wound where nail was driven in.

February 5, 1909. Wound broken down. Profuse purulent discharge.

February 12, 1909. Spike removed, under ether. It was lying loose and was extracted without difficulty.

April 2, 1909. Wound almost closed. No shortening. Considerable motion possible. Patient ordered upon crutches.

June 5, 1909. Wound still discharging. Patient on crutches.

Macros.—Head of bone badly eroded and changed in contour, flattened. No distinct focus appears in it. The cartilage is present only in small islands.

Micros.—Bone shows tuberculosis at surface. Very little fibrous tissue. Apparently very little effort at repair. Synovial membrane shows tuberculosis.

September 1, 1909. Under bismuth injections sinuses healed up in a few weeks. Now shortening of about 1 inch, and patient walks with canes. Will be discharged.

December 12, 1909. A letter from patient says that she has returned to her home, and is doing her work and caring for her children.

Synovial membrane *shows tuberculosis*. Arterial thickening.

Macros.—A focus can be plainly seen in the navicular, "stringing" out toward surface.

A. Section from navicular. B. Synovial membrane.

Lab. No. 1209.

Hospital, —.

No.

Operator,—. Admitted November 11, 1908. Discharged November 24, 1908.

Clinical diagnosis, tuberculosis of the shoulder.

Laboratory diagnosis, tuberculosis of the shoulder.

Name, E. J. Age, 20.

Sex, M.

Occupation, expressman.

Specimen.—Head of humerus and synovial membrane.

For the past two and one-half years patient has experienced a dull pain in the hollow of his right elbow. About six weeks ago, he awoke with pain in all the joints of his right arm. This grew better, but patient has since suffered from pain and disability of the arm. Cough for three years.

Exam.—Shoulder flattened, muscles about the joint atrophied. Sensitiveness of shoulder to pressure. All motions limited.

November 13, 1908. Operation. About 1 3/4 inches of humerus sawn off. Capsule trimmed close. Articular cartilages removed from glenoid, and bone curetted. Carbolic acid and alcohol. Iodoform gauze packing.

Macros.—Cartilage separated *en masse* from head of humerus. The head has been torn off the neck at epiphyseal line. Bone feels soft. Apparently a bony focus at epiphyseal line.

Micros.—Bone. Layer of tuberculosis rather thick at surface, in places enclosing small islands of cartilage. The joint cartilage has been lifted off *en masse* over a large extent. Synovial membrane full of tuberculosis.

A. Section of head and neck. B. Synovial membrane.

Primary bony focus.

A. Cartilage has been separated from bone by a thick layer of granulation tissue that is fibrous in spots. At the side can be seen one giant cell; epithelioid cells in other places. Marked rarefying osteitis under the layer of granulation tissue. Cartilage seems to have been affected only from below.

Lab. No. 1245.

Hospital, —.

No.

Operator,—. Admitted 1908.

Discharged,—

Clinical diagnosis, probable sarcoma of hip.

Laboratory diagnosis, tuberculosis of hip.

Name, P. D.

Age, 32.

Sex, M.

Occupation,—

Specimen.—Head, neck, and trochanters of femur.

Duration one year. Began with cramps in leg.

July 1, 1908. Abscess in front of thigh opened, eurented, and packed, drainage tube inserted.

December 16, 1908. Bone curetting; wound packed with iodoform gauze.

January 27, 1909. Resection of head, neck, and trochanters.

Macros.—The head of the bone is eroded and cartilage is gone. At one place there is a focus of disease. Bone sand can be felt. Synovial membrane not much thickened.

Micros.—Marked rarefying osteitis. Areas of necrosis. Great development of fibrous tissue in and about tuberculous areas. Tuberculosis scattered through head of bone. In places small trabeculae of bone have been separated and are lying, some in pus and some in granulation tissue. They have suffered from the rarefying process. Cartilage almost gone. On the head, at a distance from focus (see 2d slide), the bone shows no tuberculosis and is the seat of productive osteitis. Here are the few remnants of cartilage.

Primary bony focus.

Lab. No. 1210.

Hospital.—

No. 867.

Operator.— Admitted November 23, 1908. Discharged December 19, 1908.

Clinical diagnosis, tuberculous elbow.

Laboratory diagnosis, tuberculous elbow.

Name, B. C.

Age, 28.

Sex, F.

Occupation, housework.

Specimen.—Articular ends of all three bones.

Duration six weeks. No known cause. Pain, gradually growing worse, running down forearm, sometimes into little and ring fingers. About one month ago patient began to have trouble in arranging her hair, *i.e.*, limitation of motion. This has grown worse. About two weeks ago swelling of joint was noticed. About a year ago a single small swelling was noticed in region of the epitrochlear, which has increased in size.

Exam.—Left elbow held flexed at angle of 130° . Marked swelling extending from the interval between external condyle and olecranon, half way to wrist, soft and fluctuating, only slightly tender, and not hot. Marked atrophy of arm. Three large nodes above inner condyle, running about 3 inches up arm. All motions limited. Heart and lungs normal.

November, 26, 1908. Resection of elbow. Articular cartilages little affected, that on head of radius slightly eroded. The capitellum was found reduced to a mass of soft detritus, over which the articular cartilage remained intact. Entire synovial membrane reduced to thick, infiltrated tuberculous tissue. A large abscess extended from the joint well down the forearm, and communicated with the joint near each condyle.

Dry dressing, wire splint, rubber tube drainage.

Macros.—Bone. One spot of external condyle is broken down and disintegrated. One focus in head of radius under the cartilage. A cavity is present at the side of the olecranon lined by hard bone. All bones appeared to be involved at the sides of their cartilages. Synovial membrane thickened uniformly and diffusely in all layers.

Micros.—Bone. Extensively and deeply involved. The entire section is virtually filled with tuberculosis. Small trabeculae, showing well-marked previous rarefying osteitis, lying in tuberculous tissue, evidently dead.

Synovial membrane full of tuberculosis. Surface covered with fibrin with areas of necrosis. *Probably a bony focus.*

A. Section from external condyle. B. Synovial membrane.

Lab. No. 1254. Hospital.—. No.

Operator.—. Admitted February, 1909. Discharged.—

Clinical diagnosis, tuberculous hip.

Laboratory diagnosis, tuberculous hip.

Name, G. Age, 16. Sex, M. Occupation, jockey.

Specimen.—Head, neck, and lesser trochanter.

Pain and limp for two years. Treatment. For a while patient wore a brace, and for the past six months has been in a plaster-of-Paris spica, but pain became so severe that an operation was resorted to.

February 8, 1909. Resection, through posterior incision. The head, neck, and lesser trochanter were removed, and the acetabulum was scraped out. Iodoform powder in abundance was poured into the wound, which was sewn up with small drain, and plaster of Paris was applied.

February 15, 1909. Patient has had a severe case of iodoform poisoning.

April 7, 1909. Wound healed. About 2 inches of shortening. Brace to be applied.

January 10, 1910. Boy walking well with cane. Evidently has tuberculous wrist.

Macros.—The articular surface of head is badly eroded in entire extent, and in one area to the depth of $3/8$ inch. The rest of the head and neck appear normal. No evidence of bony focus. No epiphyseal line. Large piece of cartilage has been exfoliated.

Micros.—The articular cartilage appears as small pieces imbedded in fibrous tissue. The bone itself shows tuberculosis in two or three spots near the articular surface. No great destruction of bone as in 1245.

Synovial membrane shows tuberculosis and endarteritis obliterans.

A. Bone from head. B. Synovial membrane.

Either synovial tuberculosis or acetabular disease.

Lab. No. 1260. Hospital.—. No.

Operator.—. Admitted February 11, 1909. Discharged February 23, 1909.

Clinical diagnosis, tuberculous wrist.

Laboratory diagnosis, chronic inflammation; no tuberculosis.

Name, G. R. Age, Sex, M. Occupation.—
c/o Robinson, 131 W. 53rd St.

Specimen.—Lower end of radius and carpal bones.

Previous history unrecorded.

Exam.—On dorsum of left wrist is a fluctuating swelling, $1\frac{1}{2}$ by $3\frac{3}{4}$ inch in area. Tenderness of head of radius to pressure on the outer side of this swelling. Some sensitiveness of anterior aspect of wrist. Motion limited. Crepitus. Heart and lungs normal.

February 12, 1909. Resection of lower end of radius and ulna, and of carpal bones, except pisiform and $1\frac{1}{2}$ inch of unciform. Synovial membrane also excised. An area of necrosis was found, in outer part of articular extremity of radius, involving the cartilage and extending up into medulla. Another area in scaphoid. Tuberculous granulation tissue surrounding anterior and posterior tendons. A rice body was removed from one of the anterior sheaths.

Macros.—Focus in external part of lower end of radius. Cartilage intact. Synovial membrane apparently normal.

Micros.—Sections of bones and soft parts show no sign of tuberculosis. Focus in radius appears composed of connective tissue and fat.

Later.—New sections show no tuberculosis. The synovial membrane is thickened, and its deeper layers are composed of new granulation tissue.

Lab. No. 1354.	Hospital,—	No.
Operator,—	Admitted,—	Discharged,—
Name,	Age, 21.	Sex,— Occupation,—

Specimen.—Articular ends of femur and tibia, left.

Duration, eight years. Treated with plaster of Paris.

Operation.—April 21, 1909. Resection. Sinus in popliteal space led up into joint cavity through inner tuberosity of tibia. Inner side of joint was full of tuberculous appearing granulations. Inner condyle of femur covered by granulation tissue. Cartilage gone. Outer articular surface of both bones free. The patella was not removed, but was left adherent to anterior surface of femur.

Macros.—The inner tuberosity of tibia has been largely curetted away, leaving a cavity in the bone, from which a hole opens downward—the old sinus. The opposing condyle is covered by granulation tissue. The external portion of joint seems fairly normal.

Micros.—Bone sections show little if any abnormality. Synovial membrane thickened and in folds. Marked round-cell infiltration, a few tubercles and an occasional giant cell.

Thickening of blood vessels present, but not very marked.

A. Internal condyle. B. Tibia. C. Soft parts.

A. Only remnants of the cartilage remain, and these are covered over with fibrous granulation tissue. The fibrous tissue is continuous with the cartilage, and it is impossible to tell where one ends and the other begins, as if the cartilage itself were losing its character and becoming fibrous. At other places the granulation tissue has replaced the cartilage. The damage seems to have

been done from the surface, not from beneath the cartilage. There is no evidence of any lifting-off process. The bone appears normal, except in one or two places where the granulation tissue is invading it from the surface.

B. External tuberosity. Practically normal, except that at one spot, near attachment of synovial membrane, the granulation tissue can be seen invading the bone superficially, and that the cartilage shows a tendency to fibrillation at its free surface.

B. Internal tuberosity. Bone covered with granulation tissue. No sign of cartilage.

Lab. No. 1367.

Hospital,—

No.

Ward V, 1st Division.

Operator,— Admitted April 19, 1909. Discharged May 11, 1909.

Name, S. L. (See also 989.)

Diagnosis. Before operation, non-tuberculous arthritis.

At operation, tuberculosis.

In laboratory, tuberculosis.

Specimen.—Patella, extreme ends of femur and tibia. A small amount of synovial membrane.

April 24, 1909. Resection of knee. The external condyle, which had been scraped at the previous operation, was found tightly bound to tibia by fibrous bands, which tore apart at operation. No evidence of softening or easeation in bone or soft parts. The operator, though told of the results of the previous negative pathological examination, nevertheless considered the joint tuberculous. Bones drilled and sutured with chromic gut. Wound sewn with silk-worm gut. Drainage. Plaster of Paris.

Von Pirquet test negative.

Macros.—Bone apparently normal. Cuts hard. Cartilage is covered in places by fibrin (?). The external condyle shows the old adhesions torn off. Synovial membrane thickened. Joint surface of patella covered by dense fibrous tissue. At the side of this is a warty looking body about 1 cm. in diameter, which feels harder and firmer than the surrounding tissue. On section this has a look suspicious of tuberculosis.

A. Condyle, normal internal one. B. Synovial membrane. B². Warty growth. C. Scraped condyle (external). D. Patella at site of growth.

Micros.—All slides of soft parts made in our laboratory are negative, except that of warty growth, which shows tuberculosis. Hospital laboratory reports "soft parts riddled with tuberculosis." Obliterating endarteritis.

A. No tuberculosis. B. Negative to tuberculosis. B². Typical tuberculosis. C. Normal bone. Granulation and fibrous tissue at margin. D. No bony tuberculosis. Granulation tissue runs down to bone, but stops there.

Primary synovial tuberculosis.

December 29, 1909. Plaster of Paris removed. For past four or five months scar would break down at some spot, and a piece of catgut suture would be ex-

truded. The wound would heal. It has now been open for a day or two. Firm bony union at about 165°. No evidence of active disease. To go without plaster.

March 5, 1910. No sign of disease. Firm bony union at 165°.

January, 1911. A letter from patient says that there has been no return of the disease. He has had one or two attacks of local "soreness."

This operation was done according to my idea.

Lab. No. 1382.	Hospital,—	No.
		Ward V, 2d Division.
Operator,— Admitted April 27, 1909.		Discharged.
Name, F. P.	Age, 53.	Sex, M. Occupation, carpenter.
(See also 1191).		

Diagnosis. At operation, tuberculous knee, left.
In laboratory, tuberculous knee, left.

Specimen.—All three bones, and soft parts. About 1 1/2 inches from femur and about 1/2 inch from tibia.

Eight months ago right knee was struck by falling beam. It did not swell much, but was somewhat painful. The patient kept at work for two weeks; then the knee had become so painful that he was forced to quit. There was slight swelling and some tenderness, moderate stiffness, with sense of insecurity on motion, and occasional sharp pain. No locking.

On December 15, 1908, patient came to the hospital; at that time right knee was moderately swollen and the normal outlines obliterated. No fluctuation nor evidence of fluid. Tenderness over inner aspect of tibia. AGE. 165° AGF. 90°.

December 16, 1908. Removal of internal meniscus. Synovia thickened and inflamed. The wound never entirely healed. Patient remained in hospital eighteen days after operation. He was advised to have another operation, but refused, and left the hospital in plaster with a diagnosis of knee-joint tuberculosis. The specimen of fibro-cartilage had meantime been examined. The knee grew worse and patient returned in a carriage on April 27, 1909.

Exam.—Left knee slightly swollen. In extension. Slightest motion painful. Slight knock knee. Swelling most marked over inner aspect of knee, tenderness also. No fluctuation nor fluid. Several small crusts at site of operation wound, overlying small sinuses. Atrophy of leg. Heart and lungs normal.

May 7, 1909. Resection. Joint cavity contained about 1/2 ounce of purulent fluid. Bursa under quadriceps, and sinus tracts up behind inner aspect of femur and downward behind both tuberosities of tibia contain broken-down material. Both condylar surfaces spotted by disease areas. Patella eroded. Bone cuts easily. Patella and synovia under quadriceps dissected out. About 1 1/4 inches sawn from lower end of femur, and 3/4 inch from upper end of tibia. Other synovia freely dissected, and disease tracts everted and dissected. Bones nailed with two steel pins. Rubber drainage tubes at sides of wound—removed on fourth day. Plaster of Paris.

Macros.—The cartilages on femur and tibia are eroded, the erosion on the tibia appears to be extending from the side. Femur cuts easily. Cartilage on patella somewhat roughened. No bony focus apparent. Synovial membrane enormously thickened, but not much tuberculosis apparent to the naked eye.

A. Condyles of femur. B. Tibia. C. Synovial membrane.

Micros.—A. The cartilages are being disintegrated from below, the inflammatory tissue appearing to have spread more or less completely under them, and in places to be pushing up through them. This disintegration seems to be going on almost entirely from beneath; there is no layer of fibrin over the cartilages, and their free surface is normal, or at most, slightly irregular. The granulation tissue beneath the cartilages does not contain any typical tubercles, but these are abundant in the soft parts. Neither rarefying osteitis nor obliterating endarteritis is a part of the process.

B. Much the same as A.

C. Synovial membrane thickened and thrown into folds, but no long villi. Typical tubercles.

Primary synovial.

Lab. No. 1383.	Hospital,—	No.
		Ward V, 1st Division.

Operator,— Admitted April 28, 1909. Discharged May, 1909.

Name, O. S. Age, 22. Sex, M. Occupation,—

Diagnosis, before and after operation, anterior dislocation of hand, and osteomyelitis.

Diagnosis in path. lab., tuberculosis.

Specimen.—Two bones and fragments of third.

About one year ago the right wrist was jerked backward and sprained. This produced a slight swelling about the joint, which, for about three months, was stiff in the morning and very weak. Then a swelling was noticed on flexor surface, soft and tender. This ruptured spontaneously and discharged pus for five weeks, then healed. Since then the deformity has steadily increased, the function remaining about the same. No pain. General health good.

Exam.—Right wrist enlarged. Motion distinctly limited. Head of ulna prominent on dorsum of wrist. Carpus subluxated forward. Lower ends of styloids on same plane. Red, indurated scar about 1 1/2 inches long on palmar surface of wrist. Thickening and sensitiveness of lower end of radius. Heart and lungs normal.

May, 1909. Excision of upper row of carpus (scaphoid, semilunar, and cuneiform) and part of articular surface of radius. Rubber tissue drains. The wrist bones were found eroded and friable. No pus nor cheesy matter.

Roosevelt laboratory reports tuberculosis.

Macros.—Bones cut hard. Cartilages smooth. Apparently no bony focus in specimen.

Micros.—Sections from bone show tuberculosis. Rarefying osteitis. Cartilage smooth and practically unaffected on its free surface. Underneath it the granulation tissue has spread, but it has not interfered with the nutrition of the cartilage.

Lab. No. 1385.	Hospital,—	No.
		Ward V, 2d Division.

Operator,— Admitted April 23, 1909. Discharged May 1, 1909.

Clinical diagnosis, tuberculosis of wrist.

Laboratory diagnosis, tuberculosis of wrist.

Name, J. O'D. (Same patient as 98. *q. v.*).

Amputation of forearm. This is the operation at last resorted to, after vain attempts to cure the disease by less radical means.

Specimen.—Forearm and hand.

The forearm bones are resting in a mass of connective tissue. The tuberculous process appears to have disappeared, except at one spot, where there is a mass of tuberculous tissue, communicating with the surface by a sinus. Fragment of a carpal bone found lying in fibrous tissue. Bone cuts hard, it is sclerosed, eburnated.

Section across wall of sinus and tuberculous mass.

Micros.—Well-marked tuberculosis deep in walls of sinus. Superficially, the walls are composed almost entirely of new granulation tissue without much tuberculous involvement.

Lab. No. 1399.	Hospital,—	No.
		Ward V, 2d. Division.

Operator,—	Admitted,—	Discharged,—
------------	------------	--------------

Name, McE.	Age, 18.	Sex, M.	Occupation.—
------------	----------	---------	--------------

Clinical diagnosis, probably syphilis, before operation.

Clinical diagnosis, tuberculosis, after operation.

Laboratory diagnosis, no tuberculosis. Probably syphilis.

Specimen.—Upper extremity of femur. Left.

Duration of symptoms, one year, worse for past eight weeks. Pain, stiffness, and limp. Thigh in extension and abduction. Marked limitation of motion and muscular spasm. Atrophy. X-ray plate showed light spot at upper and inner part of neck. Sensitiveness over head.

Operation May 28, 1909. Incision over trochanter showed periosteum thickened and bone roughened under it. Bone soft, but not diseased. Periosteum dissected off neck showed soft diseased spot just outside of head. This was curetted out. Then head of bone excised. Synovial membrane injected and

swollen. Head appeared normal and cartilage smooth. Slight "pannus" over head. Head only was excised. Synovial membrane dissected off. Carbolic acid, alcohol. Sewing up in layers, with one drain. Plaster of Paris from axilla to toes in extension and abduction.

Hospital laboratory reports no tuberculosis.

A. Section of head and inner part of neck, through site of soft diseased area.

B. Synovial membrane from different parts of joint.

Micros.—Bone shows round-cell infiltration—chronic inflammation. Synovial membrane; thickened arteries. Round-cell infiltration about the vessels. Round-cell infiltration more or less general.

Chronic inflammation. Probably syphilis.

Lab. No. 1409.

Hospital,—

No.

Ward V. 2d Division.

Operator,— Admitted May 31, 1909. Discharged June 22, 1909.

Diagnosis, clinical, tuberculous shoulder.

Diagnosis, after operation, tuberculous shoulder.

Diagnosis, in laboratory, chronic inflammation.

Specimen.—Head, end of acromion, synovial membrane.

Name, J. B.	Age, 25.	Sex, M.	Occupation, hall-boy.
217 W. 63d St.			

Pain and disability of shoulder for two years.

Operation.—June 3, 1909. Resection of head of humerus. The joint contained turbid fluid. Tip of acromion necrotic. Joint capsule much thickened. Synovia ditto. "Scattered tuberculous foci through head of humerus." Tendon sheath of biceps exuded pus.

Gross.—Cartilage slightly roughened—eaten away at one portion of its circumference. No evidence of deep bone involvement. Synovial membrane thickened.

A. Bone, humerus, through eroded area. B. Synovia.

Micros.—Bone. Productive osteitis. Marked round-cell infiltration. Synovia. Thickened and in folds—chronic inflammation. Thickened blood vessels. No sign of tuberculosis.

Chronic inflammation. Probably syphilis.

February, 1910. The joint was submitted to another thorough examination, and new sections were made of those parts of it that seemed most diseased, with the following result.

Macros.—The "tuberculous foci scattered through head of humerus" on closer inspection are revealed as particles of cartilage carried in on the saw. The cartilage of the head is covered with fibrous tissue. The bone cuts hard.

Micros.—Bone is undergoing productive osteitis, and the marrow is the seat of small hæmorrhages. Synovial membrane is thickened and inflamed, and

C. Well-marked villous arthritis. Tuberculosis is present—round-cell infiltration, giant cells in one slide only—of four.

D. Free border of fibro-cartilage covered with villi, presenting evidence of inflammation.

Additional. A. Cartilage at surface is fibrillated, and in places has become frayed out, and the ends wave out. Productive osteitis is present. B. On the joint surface the cartilage has become fibrous, and is frayed in places, as in A—tatters, so to speak. Underneath the cartilage, in the bone, is a layer of granulation tissue, which in places is bursting through the cartilage. Some of the cartilage cells are replaced by empty spaces. Bone underneath is undergoing rarefying osteitis.

Primary synovial tuberculosis.

Lab. No. 1433.

Hospital, —.

No.

Ward V. 2d Division.

Operator,— Admitted April 4, 1909. Discharged August 24, 1909.

Name, W. B. Age, 30. Sex, M. Occupation, elevator man.

Diagnosis, before operation, tuberculous right knee.

Diagnosis, at operation, tuberculous right knee.

Diagnosis, in laboratory, no tuberculosis. Syphilis?

Specimen.—Resected knee.

Gonorrhea two years ago. Symptoms date from fall seven months ago.

Exam.—On admission, swelling, heat, doughy feel at limits of joint cavity.

Patella floats. No muscular spasm, nor limitation of motion.

R. T. 17 1/2—R. K. 13 1/2—R. C. 13 1/2.

L. T. 19 —L. K. 13 1/2—L. C. 13 1/2.

Exploratory operation April 6, 1909. Joint contained about 3 ounces of turbid fluid, with gelatinous masses and some blood-stained fibrin. Synovia thickened, corrugated, and reddened. Irrigation with 1-60 phenol, and specimen to laboratory. Wound sewn up tight. Posterior splint. Laboratory reports no growth of cultures, except small ones from contamination. No evidence of tuberculosis. No bacteria in fluid.

Infection followed, and on April 21, 1909, a draining operation was done. Pus in joint. Laboratory reports extracellular diplococci, streptococci, and staphylococci. This was followed by high temperature for weeks, which later subsided, and a resection was done, July 1, 1909.

Discharged improved, with small discharge from wound.

Macros.—Synovial membrane much thickened—contains much fat and fibrous tissue—covered with short villi, which do not branch. Cartilages are covered with fibrin (?) that can be stripped off with forceps. They are apparently sound, except that over patella, which has evidently been largely destroyed. Bones apparently normal.

A. Patella and condyle. B. Synovial membrane and fibro-cartilage.

Micros.—Thickened blood vessels, with round-cell infiltration about them. New granulation tissue. No tuberculosis.

February, 1910. Six new sections were made of the soft parts, taken from spots which were most badly diseased, in order to find tuberculous tissue if it were present. The synovial membrane under the microscope appeared infiltrated by round cells, and roughened in places on its free border. Hæmorrhages have taken place into its substance, and areas of necrosis are present. The free surface of some of the villi is covered with fibrin. Arterial thickening can be seen, but no tuberculosis.

Lab. No. 1500.

Hospital. —.

No.

Ward V, 1st Division.

Operator,—.

Admitted August 24, 1909. Discharged September 17, 1909. Improved (96220).

Name, R. H.

Age, 20.

Sex, M.

Occupation, seaman.

Diagnosis, before operation, tuberculous tarsus.

Diagnosis, laboratory, tuberculous tarsus.

Specimen.—Fragments of bone.

Duration, nine months. No known cause. Pain, etc.

Operation, August 27, 1909. Partial resection of tarsus. Pus obtained from navicular-cuneiform joint. Cuneiform and part of navicular removed. Wound packed.

Note. "Wound healing at time of discharge."

Macros.—Bone and synovial membrane both show tuberculosis. Bone shows productive osteitis. No sign of cartilage; its place appears to have been taken by granulation and fibrous tissue, some of which is necrotic. Some bony trabecule are also necrotic.

Synovial membrane shows large areas of necrosis. It is covered in places with granulation tissue, and shows a slight tendency to coarse villi. No obliterating endarteritis.

Lab. No. 1617.

Hospital, —.

No.

2d. Surg. Division.

Operator,—. Admitted October 19, 1909. Discharged November 5, 1909.

Name, I. L.

Age, 20.

Sex, M.

Occupation, salesman.

Diagnosis, tuberculosis of wrist.

Diagnosis, laboratory, chronic inflammation.

Specimen.—Fragments of bones.

Duration, seven weeks. Pain, swelling, disability, etc.

Resection of all carpal bones.

No other joint involved, no pulmonary complication.

Micros.—No sign of tuberculosis. Enormously thickened blood vessels.

Later.—This patient returned to the dispensary for after treatment. The wound had healed. He improved rapidly on mercury and iodide of potassium.

Lab. No. 1619. Hospital, —. 2d Surgical Division.

Operator,—. Admitted October 25, 1909. Discharged December 3, 1909.

Diagnosis, clinical, probable tuberculosis.

Diagnosis, at operation, chronic arthritis.

Diagnosis, laboratory, hospital, tuberculosis.

Diagnosis, laboratory, P and S., chronic arthritis.

Diagnosis, laboratory, final, tuberculosis.

Name, P. M. Age, 24. Sex, M. Occupation, shepherd and
(See 1670.) dishwasher.

Specimen.—Clippings from joint.

Duration, seven years. Symptoms consisted of moderate pain and disability. Joint full of fluid. Little, if any, circumarticular thickening. Dancing patella. Sensitiveness to pressure at sides of patella. Small bodies could be moved under the examining finger. No subluxation. No typical tuberculous appearance.

October 26, 1909. Operation. Long incision internal to patella, evacuating fluid. Growing from synovial membrane were numbers of bodies, size of pea to that of lima bean. Several of these were cut off. The cartilages appeared normal, so the diagnosis of tuberculosis was changed and the joint was sewn up, and the limb put up in plaster of Paris.

Discharged, improved, December 3, 1909.

The tabs removed from the joint were rather dense and the largest one, slit up, appeared composed of fibrous tissue, with a small area of calcification.

Hospital laboratory reported "typical tuberculosis," but two series of sections (A and B), made by us, failed to reveal it.

Primary synovial tuberculosis.

Lab. No. 1661. Hospital, —. No.
Ward V, 1st Division.

Operator,—. Admitted November 9, 1909. Discharged December 29, 1909.

Name, I. F. Age, 16. Sex, M. Occupation, school.

Diagnosis, clinical. Tuberculosis of left ankle.

Diagnosis, hospital laboratory, chronic inflammation, no tuberculosis.

Diagnosis, by us in laboratory, old tuberculosis.

Specimen.—Astragalus, almost entire, and other bone fragments.

Duration, eight or nine years, dating immediately from injury. Treated for five weeks with plaster of Paris. Stiffness persisted, and slight pain. Seventeen months ago the symptoms grew worse, and swelling appeared. For fourteen months he has worn plaster.

The left foot is decidedly shorter and smaller than the right, and the calf is much atrophied. The ankle is moderately swollen and is markedly limited in its motion. Induration is present on either side of tendo Achillis. Left knee-jerk is markedly exaggerated.

Von Pirquet test positive. November 18.

November 20, 1909. Removal of talus. "Soft, diseased internal malleolus" fractured in doing this. Wound sewn up without drainage. Plaster-of-Paris dressing. Stitches removed on 23d day. Uneventful healing.

Hospital laboratory reports chronic inflammation, no tuberculosis.

Specimen.—Gross. The cartilages of the articulations other than the ankle look rather thin, transparent and slightly irregular, but show no evidence of disease. The cartilage of the ankle is roughened and covered in places with fibrous tissue. The specimen here has been injured at operation. Remains can be seen of adhesions that have been torn away. At one spot in the joint is a small round fibrous nodule, about 1/4 cm. in diameter. This contains cheesy matter. Underneath this the bone looks diseased, but not in any other place. Bone cuts easily.

A. Bone from diseased looking area. It floats in water. B. Soft parts. One section goes through the fibrous nodule.

Micros.—A. Some of the trabeculae appear normal, but some are dead. There are a few signs of productive osteitis, but no other sign of activity. No rarefying osteitis is present, nor tuberculous tissue, nor any sign of cartilage in either of two sections. Fibrous tissue appears to have taken the place of the cartilage. Marked arterial thickening of the soft parts can be seen.

B. Typical old tubercle, with necrotic centre, then epithelioid and a few giant cells, then round cells, and outside all this a capsule of fibrous tissue.

Lab. No. 1670.

Hospital, —.

No.

Ward V, 2d Division.

Operator,— Admitted December, 1909. Discharged,—

Name, P. M.	Age, 24.	Sex, M.	Occupation, shepherd and
(See also 1619)			dishwasher.

Clinical diagnosis, tuberculosis of knee.

Laboratory diagnosis, tuberculosis of knee.

Specimen.—Patella, articular ends of tibia and femur, synovial membrane.

This is the same case as 1619. *q. v.*

After the patient's discharge from his previous stay in the hospital his plaster was removed, and his condition immediately grew much worse, so that he was soon sent back for further operation. His knee was swollen and tender, and presented typical appearance of tuberculosis.

December 16, 1909. Excision of knee, through typical U-shaped incision, dividing lig. patellæ. The synovial membrane was found thickened, with a few "tabs" hanging from it. Patella pronounced by operator "soft and friable," so that it broke off in forceps. Most of the cartilages were fairly smooth, but erosion of the condyles was quite advanced in areas, notably over inner condyle, where incision of former operation was. A large part of the upper part of this cartilage was eroded. A band of erosion also ran across outer condyle. At sides of cartilage the process can be seen starting in.

The synovial membrane contained several hard bodies about the size of a large pea on the outer side of the joint, which on section show cheesy degeneration. In this region, in the vicinity of attachment of synovial membrane to femur, there is a villous proliferation, and in one of these villi can be seen a tubercle, cheesy on section. In point of fact the patella is not soft and friable, but cuts as hard as the other bones. There is no sign of bony focus.

A. Condyles. B. Soft parts.

A. No bony involvement. Cells in cartilage show tendency to arrangement in groups. Cartilage shows a tendency to fibrillation on its free surface, with fibres running parallel to surface. At sides of cartilage the layer of fibrous tissue is thick, and here the cartilage occurs only in islands—it has evidently degenerated. There is no tuberculosis to be found in any of this tissue, bony or fibrous.

B. Soft parts. Synovia full of tubercles, epithelioid, giant cells, etc. Obliterating endarteritis of moderate degree. Areas of necrosis on synovial membrane.

Primary synovial tuberculosis.

Lab. No. 1672.

Hospital, —.

No.

Ward V, 1st Division.

Operator,—. Admitted December 13, 1909. Discharged December 27, 1909. Cured.

Diagnosis, clinical, joint mouse.

Diagnosis, at operation, joint mouse.

Diagnosis, hospital laboratory, inflammatory process.

Diagnosis, P. and S. laboratory, tuberculosis.

Name, L. T.

Age, 46.

Sex, M.

Occupation, pedlar.

Specimen.—Body, size of bean, about 1 cm. in diameter.

Six months ago severe pain came suddenly in left knee, without known cause. Previous vague history of discomfort "for a long time." "Joint mouse" could be felt under examining finger, external to patella.

Operation.—Removal of joint mouse. "A cartilaginous mass about 1 cm. in diameter was removed." It was found attached to synovial membrane. Synovial fluid was slightly increased, but normal in appearance.

Hospital laboratory. "Although the clinical and gross diagnosis would strongly indicate an inflammatory process, the microscopic picture is nearly, if not quite typical of giant-cell sarcoma."

On section the body was seen to contain areas decidedly different in color from the rest—paler.

Micros.—Well-marked tuberculosis is present. A few epithelioid and many giant cells can be seen. The whole mass is enclosed in a distinct fibrous capsule.

Primary synovial tuberculosis.

Lab. No. 1678.

Hospital, —.

No.

Ward V, 2d Division.

Operator,—.

Admitted December 19, 1909. Discharged January 11, 1910. Improved.

Name, G. D.

Age, 45.

Sex, M.

Occupation, teacher.

Diagnosis, clinical, tuberculosis of right knee.

Diagnosis, at operation, tuberculosis of right knee.

Diagnosis, laboratory, tuberculosis of right knee.

Specimen.—Extreme ends of bones, inner surface of patella, soft parts.

Five years ago, patient presented himself for examination on account of pain and disability in his knee, which had been troubling him for two years. The joint was swollen and presented a typical appearance of tuberculosis. Resection was advised and refused. Various treatments were tried elsewhere without avail. For past month or two, the symptoms have been much worse. Now slight posterior sub-luxation is present, and little or no motion is possible in the joint, which is very sensitive.

December 20, 1909. Operation. Resection of knee. Ely method. Incision across patella, dividing lateral aponeurosis, but not the lateral ligaments. Patella sawn through, and fragments retracted. Extreme ends of tibia and femur and inner surface of patella removed by saw and chisel, also the trochlea. Little more than the cartilages was removed, causing a shortening of about $\frac{5}{8}$ inch. Crucial ligaments not divided. Pocket of pus under cartilage on inner tuberosity, size of pea, curetted. No attempt was made to dissect out diseased synovia. Deep sutures of chromicised gut to lateral aponeurosis, superficial silk-worm gut. Cigarette drain on inner aspect (removed in 24 hours). Plaster of Paris from groin to toes. (Union by first intention, except one or two small granulating areas.)

Pathology.—Bones cut hard. When condyles were sawn off, fat globules ran out. No bony focus, unless the collection under inner tibial cartilage could be considered such. Otherwise the bones were in good condition. Cartilages fairly smooth, except at periphery. Synovial membrane thickened. Pocket in tibia contained pus and was lined by granulations.

A. Bone. B. Soft parts.

- A. Inflammatory tissue has made its way under the cartilage, and in places seems to be pushing up through it. This granulation tissue has no distinct tuberculous appearance. Bone elsewhere is normal. The cartilage cells show tendency to arrangement in groups of six or eight, and in places, especially in the middle of the section, the matrix is distinctly fibrous in appearance, with the fibres running parallel to the surface as they approach it, and merging into the fibrous tissue on it. At the sides of the slide, on the other hand, the granulation tissue is distinct from the roughened cartilage on which it lies. The fibrous tissue, in other words, lying on the cartilage, may be regarded as degenerated cartilage matrix. Rarefying osteitis is present in one bone section.
- B. Typical tuberculosis. Moderate arterial thickening. An abundance of new-formed, partly organised granulation tissue can be seen in the synovia, and a well marked fibrous encapsulation of the individual tubercles.

Probably primary synovial.

December, 1910. A letter from patient says that there has been no further evidence of disease, except occasionally a slight feeling of soreness, which soon passes away. He walks great distances without any form of support.

Lab. No. 1698.

Hospital, —.

Operator, —. Admitted December 22, 1909. Discharged, —

Name, C. T. Age, 4. Sex, M.

Diagnosis, by all men in dispensary, congenital syphilis.

Diagnosis, before application to dispensary, tuberculous knee.

Diagnosis, at operation, tuberculosis, osteomyelitis chronica.

Diagnosis, laboratory, hospital, tuberculosis.

Diagnosis, laboratory, P. and S, tuberculosis.

Specimen.—Two sequestra, pieces of involucrum, soft parts.

Eighteen months ago, child acted sick; he had fever, and waked up one morning unable to move his right leg. He was treated for rheumatism and a few days later abscesses appeared on inner side of thigh, opened and healed up. One year ago abscess appeared on upper part of right tibia. It was opened and has never healed. About same time ulcer appeared on lower inner part of leg. For past nine months boy has had swelling of right index finger which was painful at first, but not now. He has been treated with an ordinary knee brace. Since applying at the dispensary he has been under anti-syphilitic treatment.

He has an ulcerating, granulating area about as big as a silver dollar on the front surface of the right tibia, with undermined edges. Another sinus further down on leg. After six weeks of dispensary treatment an x-ray plate was taken, and something like this was revealed—two large sequestra in a cavity which ran up into the epiphysis. *The joint itself at no time had been involved—* no swelling, no fluid, no limitation. An x-ray picture of hand shows a typical tuberculous spina ventosa.

December 27, 1909. Operation. Cavity chiseled into, and pus found (reported sterile). The cavity was lined by granulations, and in these two large sequestra were found as big as a hazel-nut, that could be easily plucked out by forceps. The sinus lower down on leg also communicated with cavity.

A. Involuerum. B. Soft parts.

A. No tuberculosis. Very dense bone. Rarefying osteitis.

B. Tuberculosis, and a great production of new granulation tissue.

Lab. No. 1715.

Hospital,—

No.

Ward 10.

Operator,— Admitted February 5, 1910. Discharged,—

Name, T. T. Age, 40. Sex, M. Occupation, Labourer.
1576 Third Ave.

Diagnosis, tuberculous right knee.

Diagnosis, laboratory, tuberculous right knee.

Specimen.—About $5/8$ inch of femur, about $3/8$ inch of tibia, patella, synovial membrane, and a flake of cartilage of unknown origin.

Fifteen months ago, without known cause, patient began to have dull ache in right knee. Six months later, swelling and stiffness began and have grown worse, but the patient worked until five months ago. For past few days walking has been impossible. No rational treatment during this time. A cough has been present for past fifteen months, and one year ago the patient had fever, night sweats, and small hæmoptyses for a while. Fifteen years ago he underwent operation for abscess in back, near the spine. No family tuberculous history.

Exam.—Knee in flexion, change in contour, swelling fusiform, circumference 4 cm. greater than left. Slight atrophy of thigh and calf. No redness nor heat. Motion limited and painful. Tenderness over inner aspect of head of tibia, along joint line, and over inner condyle. Marked pulmonary involvement on left side. Positive von Pirquet test in eighteen hours.

February 7, 1910. Excision of knee. Incision above patella, and removal of this bone. Division of lateral and crucial ligaments. Synovia and "part of capsule" were tuberculous in appearance, with soft granulation tissue, but no caseation. Bones removed, synovia dissected out, and wound sewn up tight, with deep stitches of plain gut, and superficial silk-worm gut. Two ten-penny nails driven through bones. Plaster of Paris. No infection. Nails removed on fifteenth day.

Laboratory Exam.—Gross. Synovial membrane much thickened, and on section shows hypertrophy and few nodules. Cartilages of the tibia and femur slightly roughened, and in places eroded at their margins. The involvement of the patellar cartilage is greater, and at the sides the cartilage is concealed by the hypertrophied synovial membrane, which appears to have encroached upon it, but in reality simply covers it.

The bones appear normal, except the posterior part of the tibial head, which is badly involved. Just posterior to the insertion of the crucial ligaments and

to the side the bone is eaten away immediately under the cartilage, and a sequestrum about 50 x 30 x 20 mm. fell out when the bone was sawn for sections. All the bones cut easily, but do not float in water.

A. Femur. B. Tibia. C. Synovial membrane. D. Sequestrum.

A. Well marked tuberculosis of the bone, which extends in about 25 mm. from the surface, and has loosened the cartilage. A few of the trabeculae in this tuberculous tissue are necrotic. Deeper in they are undergoing rarefying osteitis.

B. One of the sections is a U-shaped piece, from whose concavity the sequestrum dropped out in cutting. Its walls are composed of tuberculous tissue, some of which is necrotic. Some of the trabeculae are dead. The whole section is badly involved and shows no trace of cartilage. Another section shows the tuberculous tissue eating in from the side, and advancing in a regular layer under the cartilage, raising it off and causing its degeneration. At the side the cartilage is fibrillated. Further in, its structure is more or less broken up, and its surface is covered with fibrous inflammatory tissue, rich in cells, but not tuberculous. Further in, again, the structure of the cartilage is blurred. Another section shows extensive tuberculous involvement with necrotic trabeculae at the surface, lying in necrotic soft tissue.

C. Six sections of synovial membrane show tuberculosis throughout their entire extent and thickness. There is a well-marked proliferation of loose, poorly-organised fibrous tissue through the tubercles, and no indication of "necrotic layers of fibrin" at the surface. Areas of necrosis are scattered all through the membrane, and the arteries of the soft parts have thickened walls.

D. Typical sequestrum—dead trabeculae lying in necrotic tissue.

Either *primary synovial* or *primary bony*, probably the former.

Lab. No. 1322.

Hospital,—

No. 5966, Ward, M. 2.

Operator,—

Operation, April 29, 1910.

Specimen.—Ends of radius and ulna, two carpal bones, soft parts.

Macros.—The joint surface of forearm bones seems diseased. The specimen has been broken up in removing. The carpal bones also are affected.

A. Radius cuts hard when diseased area is passed. Carpal bones cut easily.

B. Soft parts.

Micros.—A. Radius—badly diseased, tuberculous. Cartilage broken up from beneath, granulations bursting through.

Carpus. Same as radius. Cartilage split up in places, splits running parallel to surface.

B. Well-marked tuberculosis. Thickened arteries.

Laboratory diagnosis. Tuberculosis.

Lab. No. 1723.

Hospital,—

February 11, 1910

Specimen.—Tissue from knee. Epiphysis of femur, soft parts.

A. Femur—cuts very easily. B. Synovial membrane.

Micros.—A. Normal bone. B. Typical tuberculosis. Much new granulation tissue. Obliterating endarteritis.

Lab. No. 1724.

Hospital,—.

Operator,—.

Operation, February 26, 1910.

Name, J. H.

Age, 47.

Sex, M.

Occupation, elevator-man.

Clinical diagnosis, tuberculosis of right knee.

Laboratory diagnosis, tuberculous of right knee.

Specimen.—Patella, about $3/8$ inch of condyles of femur, and $3/16$ inch of tuberosity of tibia. Clipping of synovia.

History.—Duration, two months. Pain, rapidly increasing, limp and disability. Examination showed knee in slight flexion, no circumarticular swelling. Small amount of fluid in the joint, slight change in contour, moderate restriction of motion.

Skiagram showed blurring of outlines of bone. Von Pirquet test positive.

Operation.—Author's excision. Incision straight across patella, opening joint and letting out 1 or 2 ounces of clear fluid. Patella sawn across and joint inspected. The articular cartilage of femur was eroded, that of tibia unaffected. Synovia apparently normal. The patella was next dissected out "subperiosteally." About $3/8$ inch was sawn from condyles of femur, about $3/16$ inch was chiseled from tuberosities of tibia, loosening by mistake the attachment of the crucial ligaments. A snipping was removed from synovia for diagnosis, otherwise no soft parts. Focus of disease found in external condyle, about $1/2$ by $1/4$ inch in diameter. This was lightly scooped out. The wound was then sewn up with deep sutures of iodised catgut and superficial sutures of silk-worm gut—no drainage. Plaster-of-Paris bandage—knee in full extension.

The plaster was removed in about four weeks and the sutures were taken out. Another plaster bandage followed.

February, 1911. The patient wore plaster for about eight months. A letter dated February 7, 1911, from Dr. Albee says the knee is apparently well. No signs of active disease, no sinuses. There is very slight motion remaining, to be elicited only when force is used.

Specimen.—

Macros.—Cartilage over condyles somewhat roughened, more so over external condyle. Cartilage of patella also roughened, that over tibia practically normal. In the external condyle is a somewhat oval focus about 1 cm. in diameter, through which the saw passed at operation. Bones cut hard. Synovia succulent.

Micros.—A. External condyle, through focus. The bone shows marked rarefying osteitis all through the section. The focus is composed of poorly organised new granulation tissue and of delicate fibrous tissue, but shows no tuberculosis. The cartilage in places is fibrillated, with the fibres running vertical to the surface in the deeper portions, parallel to it in the superficial portion. In places the cartilage is badly broken up. Under the cartilage the bone shows rarefying osteitis.

B. Synovia. Well marked tuberculosis. Some tendency exists to the production of fibrous tissue, but new granulation tissue strongly predominates. In the small villi no tuberculosis can be distinguished. Marked obliterating endarteritis.

Lab. No. 1737.

Hospital,—.

Operator,—.

Operation, March 12, 1910.

Name, J. T.

Age, about 45.

Sex, M.

Occupation, machinist.

Clinical diagnosis, tuberculosis of right hip.

Laboratory diagnosis, chronic arthritis.

History.—Duration of disease, four years. Pain and stiffness in groin and in knee. Atrophy of thigh. Hip in adduction and external rotation. Limitation of motion well marked. Von Pirquet reaction positive. Skiagram shows "disease of head and neck."

Treatment.—Resection through anterior incision. When capsule was opened a clear yellow fluid escaped. The cartilage was found eroded, and the synovia velvety, thickened, and succulent. The neck was chiseled off at base and removed piecemeal. Wound sewn up tight. Long plaster spica from axilla to toes.

The subsequent course was more or less uneventful. Patient wore plaster for about two and a half months, and then began to go about on crutches. The stitches stayed in for about two and a half months. Later the patient used a cane. Three and a half months after the operation the affected limb was about 1/4 inch shorter than its fellow. Nine months after operation the patient was walking on his leg, but it was still painful.

The laboratory examination failed to show any signs of tuberculosis.

Lab. No. 1739.

Hospital,—.

Operator,—.

Operation, March 15, 1910.

Name, L. H.

Age, 21.

Clinical diagnosis, tuberculosis of ankle.

Laboratory diagnosis, tuberculosis of ankle.

Specimen.—Talus and portions of the calcaneus.

Operation.—Resection of talus. The bone was found very soft in its anterior portion—new soft granulation tissue in abundance in the soft parts. The ankle-joint appeared fairly normal and its cartilages smooth. The talus was removed, the upper portion of the calcaneus, also soft, was scraped out, and the curette was freely used. Carbolic acid was applied, followed by alcohol.

Macros.—All the bone cuts easily. The front portion of the specimen seems more diseased than does the ankle.

Micros.—A. Section from talus at ankle-joint. Bone under cartilage seems fairly normal except that the trabeculae seem small and thin.

B. Soft parts. Synovia typically tuberculous. Abundant new granulation tissue at surface. Deeper in, fibrous tissue surrounds the tubercles. Obliterating endarteritis.

- Micros.*—A. Condyles. The section of inner condyle includes the pinhead defect. Under it is an old focus of disease, about 3 mm. in diameter. It is an old healed encapsulated focus containing a few tubercles with several giant cells, surrounded by a network of delicate fibrous tissue. The whole lies directly under the articular cartilage. About the periphery of the focus the trabeculae are numerous and thick, as if they had been piled up for protection, and they are reinforced in places by bundles of fibrous tissue. Along one side of the focus, running at right angles to the articular cartilage, is a chain of small islands of cartilage, three or four in number.
- B. Tibia through softened area. Bone shows rarefying osteitis immediately under the periosteum. This slide shows well the gradual commencement of the articular cartilage as a thin layer between the periosteum and the bone, increasing in thickness as the joint cavity is approached.
- C. Synovia. Beautiful synovial tuberculosis, with many of the tubercles fairly well encapsulated.
- D. A few rice bodies have been caught in the section.

This specimen is probably a case of old bony type, with the original focus or one of the earlier areas healed. Later an extension to the synovia. The whole process seems to confirm the truth of the observations that rice bodies are found in the slower, milder forms. The encapsulation of the rice bodies and the rice bodies themselves, therefore, may be regarded as incidents in the reparative process. We see in this joint no evidence of any precipitation of fibrin.

Lab. No. 1790.

Hospital.—

Operator.— Admitted April 27, 1910. Discharged May 28, 1910. Cured.
Operation, amputation. April 29, 1910.

Name, J. O'H. Age, 44. Sex, M. Occupation, driver.

Clinical diagnosis, tuberculosis of right tarsus.

Laboratory diagnosis, tuberculosis.

Specimen.—Entire foot.

History.—Duration, twenty months. Symptoms, pain, disability, etc., beginning gradually. Patient has been treated with plaster-of-Paris, and is now on crutches. Examination shows moderate swelling over dorsum of foot, and sensitiveness. Foot in eversion. Lungs diseased. No sinuses in foot.

Macros.—Ankle-joint not involved. Several synovial cavities of the foot diseased, and the bones entering into their formation. The talo-navicular was the worst. Cartilages mottled and eroded at their periphery. Synovia thickened and inflamed. The disease probably started in talus or in navicular. During the operation a sinus was cut across running upward from one of the tarsal joints, on the dorsum of the foot, but not communicating with the surface.

Micros.—A section of the synovia showed typical tuberculosis. A section of the walls of the sinus showed the ordinary evidences of inflammation—round cells, polymorphonuclears, œdema, etc., but no tuberculosis.

INDEX

A.

Abscesses.....	32, 41
Abscesses, treatment of.....	41
Etiology of joint tuberculosis.....	3
Amyloid.....	41
Animal test.....	53
Ankle disease.....	156
Ankylosis.....	28, 84
Appendix.....	186
Arthrectomy.....	98
Arthritis, acute infectious, differential diagnosis of.....	58
Arthritis, gonorrheal, differential diagnosis of.....	56
Astragalectomy.....	158
Atrophy.....	32

B.

Beck's paste.....	82
Bone sand.....	13
Braces.....	75
Bier treatment.....	76

C.

Caisson disease, differential diagnosis of.....	63
Calcaneus disease.....	161, 163
Calmette test.....	49
Calot head-sling.....	121
Calot jacket.....	121
Calot's formula.....	81
Campbell brace.....	151
Caries sicca.....	13
Caries spinalis, see Pott's disease.....	103
Cartilage.....	24
Charcot's joint, differential diagnosis of.....	59

D.

Dactylitis.....	179
Duplay's bursitis.....	171

Deformity.....	64
Diagnosis.....	44
Differential diagnosis.....	56
Double hip disease.....	141

E.

Elbow, disease of.....	173
Ely shoulder brace	172
Environment, influence of	4

F.

Fascia tuberculosis, primary	35
Fever.....	41
Fibrillation of cartilage.....	25
Fibrin, coagulation of, in joints	24
Fingers, disease of.....	179
Focal operations.....	97
Focus, bony.....	11
Focus, synovial.....	18
Fracture, differential diagnosis of.....	59
Frequency of tuberculous joint disease	7

H.

Hæmarthrosis, differential diagnosis of	60
Heredity.....	4
Hip-joint disease.....	128
Histories.....	192
History.....	44
Hysterical joint, differential diagnosis of.....	62

I.

Infectious disease, acute.....	7
Injury.....	5

J.

Joint fungus.....	14
Joint neurosis.....	62

K.

Knee-joint disease.....	145
-------------------------	-----

L.

Leucoeytosis	53
Ligaments.....	23
Lipoma arborescens.....	18

Lorenz spica.....	135
Lorenz stirrup.....	136

M.

Marmorek's serum.....	76
Meningitis.....	41
Moro test.....	51
Mosetig-Moorhof's wax.....	81
Muscle tuberculosis, primary.....	36
Muscular atrophy.....	40
Muscular spasm.....	39

O.

Obliterating endarteritis.....	20
Occurrence of joint tuberculosis.....	7
Origin of joint tuberculosis.....	8
Osteitis, productive.....	13
Osteitis, rarefying.....	13
Osteo-myelitis, acute, differential diagnosis of.....	58

P.

Pannus.....	24
Pathogenesis.....	37
Pathology.....	8
Periosteal disease.....	8
Physical examination.....	44
Plaster of Paris.....	73
Plaster-of-Paris jacket.....	118
Pott's Disease.....	104
abscesses in.....	106
diagnosis.....	111
differential diagnosis.....	112
pathology.....	103
prognosis.....	114
symptomatology.....	107
treatment.....	115
Pott's paraplegia.....	126
Primary involvement.....	8
Prognosis.....	64
Pulmonary tuberculosis.....	41
Pyogenic membrane.....	35

R.

Recumbency.....	72
Rheumatism, differential diagnosis of.....	57
Rheumatism, tuberculous.....	42
Rice bodies.....	18
Röntgen rays.....	46

S.

Sacro-iliac disease.....	177
Sarcoma of bone, differential diagnosis of	59
Scratch bandage.....	74
Scurvy, differential diagnosis of.....	59
Shoulder, disease of.....	169
Sinuses, treatment of.....	81
Spina ventrosa.....	179
Sprain, differential diagnosis of.....	60
Still's disease, differential diagnosis of.....	59
Symptomatology.....	39
Synovectomy.....	98
Synovial disease.....	18
Synovitis, differential diagnosis of.....	58
Syphilis, bone, differential diagnosis of	56

T.

Tarsal disease.....	160
Taylor brace.....	117
Thomas hip splint.....	137
Thomas knee brace.....	151
Thomas sling.....	173
Tissues involved.....	8
Toes, disease of.....	179
Traction.....	72
Traction hip splint.....	137
Treatment.....	66
by bismuth paste.....	82
by braces.....	75
by cupping.....	78
by drugs.....	67
by extension in bed.....	73
by hyperemia.....	76
by injections.....	79
by Marmorek's serum.....	76
by plaster of Paris.....	73
by recumbency.....	72
by tuberculin.....	76
by vaccines.....	76
conservative.....	71
general.....	66
local.....	67
mechanical.....	71
of abscesses.....	81
of ankylosis.....	85
of anorexia.....	67
of constipation.....	67
of fever.....	67
of pain.....	66

Treatment of sinuses	81
radical	86
Tuberculin	76

V.

Vaccines	76
Villous arthritis, differential diagnosis of ...	58
Von Pirquet test	50

W.

Whitman-Bradford frame	115
Wrist, disease of	166

University of California
SOUTHERN REGIONAL LIBRARY FACILITY
Return this material to the library
from which it was borrowed.

APR 27 1989

SCIENCE, REASON, AND ETHICS



A 000 333 973 6

Un
S